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THE EXPORT TRADE AND STANDARDIZATION.

Among the greatest of the factors which have placed American manufacturing methods on such a high plane as compared with those of other countries are the practice of standardizing all of the parts of machines and that of standardizing types. This practice results not only in the highest grade of workmanship through the employment of special tools, and in the reduction of cost through duplication, but is extremely advantageous in the case of plant repairs and extensions. Recently the tendency has been toward carrying the practice a step further, it being proposed in the case of electrical machinery to standardize the revolutions, size of shaft and engine connections of direct connected units. A tendency in another direction has recently been fixed by the work of the American Institute of Electrical Engineers with respect to standard requirements as to efficiency, rating, regulation, heating and insulation, and the recommendations of the Institute have already been adopted by many of the most prominent electrical manufacturing companies.

The benefit derived by American users of machinery from this practice of standardization would also largely accrue to foreign users, and this is especially true with respect to the last mentioned particulars. In the absence of explicit specification the rating of a dynamo, for example, is quite indefinite, and the same remark applies to other points. Now that American manufacturers adhere to definite standardization rules, which, moreover, have been fixed by an authoritative body and guidance furnished by it as to the determination of fulfilment, foreign purchasers of American electrical machinery are safeguarded in an almost ideal manner. Instead of having to deal with specifications differing among themselves in their details, and each subject to various interpretations when it comes to determining their fulfilment, the buyer can simply require that the Institute rules apply, and then has at his disposal indications devoid of ambiguity, and of an authority that cannot be disputed, by means of which to satisfy himself concerning his purchase.

EXCITERS FOR INVERTED ROTARIES.

There will be found on another page a description of a highly ingenious arrangement for preventing rotary converters, deriving their power from a source of direct current and generating alternating current, from fluctuating in speed when their field strength is affected by variations of the power factor of the alternating-current output. The means used for this purpose take advantage of a phenomenon of self-exciting direct-current machines not commonly utilized and generally considered a great disadvantage. This phenomenon is the instability of the voltage of such machines when working with a magnetic density below saturation. In the application described on another page this phenomenon is made use of by driving the shunt-wound exciter by the inverted rotary itself, this shunt-wound exciter being worked normally well below the bend od its saturation curve. If, for any reason, the speed of the rotary, and hence that of the exciter, rises, the voltage of the exciter begins to build up and continues to do so until the speed is restored to normal by the increased field strength of the converter.

The action differs from that of any other method of internal automatic regulation in dynamoelectric machinery in that as soon as the quantity to be regulated departs from normal the action commences and continues automatically until the normal condition is restored.

In this respect the action resembles that of relay controlled devices, such, for instance, as the friction or magnetic clutch that is used in some types of water wheel governors or arc machine regulators. As is the case with these clutches, the restoring tendency goes into action as soon as the normal condition is departed from and continues to act until the normal condition is restored. In the method of exciting inverted rotary converters, however, there is absolutely no danger of overrunning, and the action is more rapid as the speed departs more widely from normal and slows down as the normal speed is approached. This cumulative, or successive action and reaction of an armature and its self-exciting non-saturated field giving an unstable voltage deserves other applications in the automatic regulation of dynamoelectric machinery, particularly in the voltage regulation of generators, for which it should not prove difficult to find a means of applying it.

The Volta Contact Force.

Ever since Volta's memorable announcement of the difference of electrical potential accompanying the contact of two dissimilar metals, electricians have been experimenting and speculating upon the nature and cause of this remarkable phenomenon. It was first supposed that because the potential difference immediately followed the contact of the two metals, that the source of this difference lay at and in the surfaces brought into contact. It has since been decided, however, that such a conclusion was not warranted. If a zinc plate brought into contact with a copper plate in air is positive to the latter to the extent of one volt, and if when the couple is immersed in dilute sulphuric acid the potential difference is still in the neighborhood of one volt, then if this difference of potential has its seat in the contact between the zinc plate and the copper, energy should be absorbed into the circuit at this junction when the couple is allowed to send a steady current. As a matter of fact, however, we know that only a very small amount of energy is released or absorbed at any pair of metallic contacts in a voltaic circuit, and that the energy which supplies the electric current is absorbed beneath the surface of the electrolyte, or in those portions of the cell in which there is no contact of dissimilar metals. The conclusion has, therefore, been reached in recent years that the source of potential difference lies in the contact surfaces of each metal and the surrounding medium, such as oxygen, air, hydrogen, water, etc., and that this potential difference lies latent and imperceptible to the senses until two dissimilar metals are brought into contact, which electric communication necessitates an equalization of their relative potentials accompanied by a charge upon the surface of both.

In the January number of the *Philosophical Magazine* Mr. F. S. Spiers describes a series of experiments in which he endeavored to prove this conclusion, which had been previously arrived at by inference only. His plan was, broadly, to measure the potential difference between two chemically pure metals with clean surfaces, first in air, and then in vacuo, after all the air had been removed. The experimental difficulties in the way of such an investigation are very considerable. We live our lives at the bottom of an atmospheric ocean many miles in depth, and everything we touch is, in a certain sense, saturated with air. Every piece of metal contains crevices which are filled with it, and upon the surface of every metallic object there seems to be a film of condensed air which is as tenacious as enamel, and can only be driven off with great difficulty in a vacuum chamber. This difficulty is practically experienced by the incandescent lamp maker when he exhausts the air from a lamp. The carbon filament contains occluded within it a relatively large quantity of imprisoned air, which has to be gradually driven out by very slowly heating the filament electrically, while still on the pumps, to a white heat; otherwise the filament would burn up in its own occluded oxygen, when first used by the purchaser.

Mr. Spiers describes the great difficulty he experienced in getting rid of the oxygen in his plates. He found, for example, that when a freshly cleaned aluminum plate was shut up in a glass tube, which was washed out with dry hydrogen, then exhausted, and this process of washing in hydrogen and exhausting repeated three times, there was still enough oxygen occluded within the aluminum plate to oxidize its surface as soon as the plate was heated in the high "vacuum" of residual hydrogen gas. Finally, a fair degree of success was attained with a couple consisting of iron and platinum. The potential difference between these plates in dry air was 0.37 volt with the iron plate positive. The repeated washing and exhaustion of the plates in hydrogen accompanied by heating slowly drove out the occluded air, and if an oxide of iron was actually formed on the surface of the negative plate, this oxide must have been reduced by the hydrogen gas, at the temperature to which the apparatus was raised. The final potential difference of the couple in hydrogen was found to be — 0.06 volt, or with the platinum plate positive. Consequently Mr. Spiers considers that the substitution of an environment of hydrogen for an environment of air, changes the potential difference of an iron-platinum couple from + 0.37 to — 0.6 volt, or effects a total change of about one volt. This seems to prove that the potential differences ordinarily observed are dependent in by far the greater measure upon the nature of the environing gas or liquid, and only in a small degree upon the contact between the metals themselves.

Magnetic Properties of Alloys of Aluminum and Iron.

In the days before the introduction of soft open-hearth steel into dynamoelectric machinery, cast-iron had to be used in the field magnets of motors unless soft iron forgings were employed. The cast-iron has a low maximum permeability—about nine kilogausses in practice. It was found, however, that the addition of a small percentage of aluminum to the casting improved the permeability. An analysis showed, however, that in the finished castings the aluminum was conspicuous by its absence, and that the advantage of using the aluminum lay in the readiness with which it entered into combination with impurities, the said combinations being eliminated from the cast metal either as a slag or in the gaseous form. The result was a more nearly pure cast iron with a slightly improved permeability. As soon as the quantity of aluminum added to the casting was sufficient to leave a residual amount of aluminum in the finished product the permeability began to diminish.

Dr. S. W. Richardson has published a paper in the January number of the *Philosophical Magazine* upon "The Magnetic Properties of Alloys of Iron with a Fairly Considerable Quantity of Aluminum." He tested three alloys containing roughly 3½, 10 and 18 per cent. of aluminum, respectively. The first was a soft alloy, but the last two were too hard to work in the lathe. It seems, however, that the two last contained a fairly considerable quantity of combined carbon, while the first had but little, so that the alloys differed not only in their contents of aluminum, but also in their contents of combined carbon. The 3½ per cent. alloy did not reveal any noteworthy properties at ordinary atmospheric temperatures. The 10 per cent. alloy was remarkable in the fact that between the temperatures of 0° and 100° C. its permeability was reduced to about one-third. Thus, for a magnetizing force of 6.75 gilberts per centimeter the permeability diminished from 1200 to about 400 gausses. In other words, the reluctivity at the temperature of boiling water was about three times as great as that at the temperature of freezing water. The ratio seemed to increase with the strength of the magnetizing force, and the most sudden descent in the permeability curve occurred in the neighborhood of 30° C. A similar but smaller

effect was noticed with the 18 per cent. alloy, and was practically confined to a range of temperature between — 20° C. and + 20° C.; while the permeabilities developed were very low.

If 10 per cent. aluminum alloy could be depended upon in every instance to behave in this manner, it might be possible to utilize in the arts this interesting magnetic sensibility to temperature. There would, of course, be the difficulty in working such hard material, but this difficulty might be minimized in designing the structure. An electromagnet having its magnetic circuit composed of such an alloy might be excited with a uniform number of ampere-turns so as to develop an uniform magnetomotive force, and yet the magnetic flux would be about twice as great at 20° C. as at 70° C. Such an electromagnet might readily be made to attract and release its armature thermostatically by the difference of magnetic flux thereby produced within this range of temperature. In the ordinary magnetic circuit of soft cast-iron or soft steel, it is not customary to introduce any correction for the temperature effect upon reluctivity, and the flux through the steel cores of a street car motor are supposed to be practically the same at 90° C. as at 10° C. The great change in reluctivity occurring within the range of ordinary temperatures of machinery evinced in this 10 per cent. alloy of aluminum is therefore particularly interesting.

Large Alternators.

The sizes of electrical generating units and particularly of alternators, are rapidly becoming so large that the engines required to drive them rank with the most powerful engines of the largest ocean steamships. On another page there will be found a description of alternators rated at 3500-kw and driven by engines rated at 4500-hp at the cut-off of maximum economy, and capable of working up to 7000 or 7500-hp. Even these machines are far outclassed by some now under construction for the Manhattan Elevated Railway of New York City, which will have twice the power of those driving the machines described on the following pages. Figuring the maximum capacity of the Manhattan engines as twice that estimated for the Metropolitan engines, the former will be used to deliver some 14,000 or 15,000-hp apiece when operating with maximum steam admission. The largest examples of marine practice are somewhat ahead of this, the new Hamburg-American ship Deutschland, for instance, having engines designed to indicate 16,500-hp each in regular service.

The building of generators for such great powers naturally involves quite a few special problems. The parts become so large that their shipment becomes a matter of difficulty. For instance, the two semi-circular halves of the external armature frame of the machine illustrated in the following pages are 21 feet in one direction by 11 feet in the other, and stand so high on a freight car that any increase in their size would prevent their being shipped, owing to tunnels and low bridges on the railways. The spider of the revolving field is itself about 14 feet in diameter, and presents a similar difficulty. For this reason, as well as on account of the difficulty of casting and handling such parts, larger machines will have to be made with their external frames in more than two sections and with spiders made up of more than one casting. This was probably one reason for not making these machines of larger diameter, a change which might have improved them in some respects. The speed of rotation of these machines is extremely low, 75 r. p. m., a condition which, as a rule, forces the diameter out to such a value that the axial length of the armature core and active windings is extremely short compared with the other dimensions of the machine. In this case, on account of the great amount of power, the axial length of the core becomes about twice the polar pitch, as is evident from the coils shown in the view of the uncompleted armature. With a greater diameter these coils would become more nearly square. On account of the high voltage under which these machines deliver their output and the consequent small size of the armature conductors and necessary thickness of insulation, a coil winding with only six slots per pole was chosen. With a larger diameter these slots could have been made either larger or more numerous. In the former case there would be more room for insulation and in the latter the many advantages of greater distribution would be obtained.

It is interesting to compare these generators with those of the same frequency and almost exactly the same rated output in use at Niagara Falls, the two types of machines being very different from each other owing largely to the great difference between their speeds of rotation. As the Niagara machines run at 250 r. p. m., they have only 12 poles, while the Metropolitan machines require 40 to give the same frequency of 25 cycles per second at 75 r. p. m. The Niagara machines have a diameter at the air gap of about 10 feet, giving them a peripheral speed at the air gap of 7800 feet per minute. The Metropolitan machines are 16 feet 8 inches in diameter at the air gap and consequently have only about one-half this linear speed, or 3900 feet per minute. On account of this the polar pitch of the Niagara machines is about twice that of the Metropolitan machines, giving room for more armature ampere turns per pole. Because of this increased number of armature ampere turns it is difficult to obtain a sufficient number of field ampere turns in the Niagara machines to give anything like close regulation without saturating the magnetic circuit up to such a point that there would be little margin for necessary variation of terminal pressure. On this account, although the Niagara machines have a ¾-inch air-gap, their field exciting current must be increased 50 per cent. from the no-load value to maintain normal potential difference between the terminals with full-non-inductive load. The short-circuit current of the Niagara machines with full-load excitation is about twice the rated current output. In the Metropolitan machines the density is carried somewhat higher around the bend of the saturation curve, so that it only requires about a 10 per cent. increase of the no-load exciting current to obtain the rated pressure with full non-inductive load. The short-circuit current with full load excitation is about two and two-thirds times the rated current output. On account of the fact that the Niagara machines deliver their output at a voltage one-third as high as the Metropolitan machines and have a correspondingly greater cross-section of conductors and smaller thickness of insulation, the Niagara machines are bar wound, while the Metropolitan machines, as pointed out above, are coil wound. The Niagara machines have only one bar per slot, giving them a large number of slots, there being 27 per pole, while the Metropolitan machines have only six per pole. On this account, and on account of their wide air gap, the Niagara machines have solid poles while the Metropolitan machines require laminated poles.

The losses and efficiencies of the two types differ considerably owing to the high speed and comparative compactness of the Niagara type. The iron loss of one of the Niagara generators is about 32-kw, while that of a Metropolitan machine is about twice as great, or 62-kw. The armature copper loss of a Niagara machine at full load is 29-kw, while that of a Metropolitan machine is slightly less, or 26½-kw. The field copper loss of a Niagara machine is 7½-kw, while that of a Metropolitan machine is four times as great, or 30-kw. The efficiency of the Niagara generator runs over 98 per cent. at full load, while that of the Metropolitan type runs up to 97 per cent. only at a 25 per cent. overload. The efficiency of the Metropolitan machines naturally falls off with reduced loads much more rapidly than does that of the Niagara machines owing to the comparatively high iron and field copper losses of the former.

Telephone Opposition in New York.

In our issue of last week an article was printed entitled "Telephone Opposition in New York," with an introductory paragraph stating that it presented a view of the present telephone situation in New York from the standpoint of the company now occupying the field. Our attention has been directed to certain passages in the article, which make unsupported statements that may be construed as reflecting on the good faith of the Knickerbocker Telephone Company. We regret extremely that statements should have crept into these columns open to such a construction. The organizers and officers of the Knickerbocker Telephone Company are gentlemen of high personal and business standing, and we desire to correct any adverse impression a reading of the article might give as to the good faith of the management of the company or the legitimacy of its methods.

Sale of Siemens-Halske Company.

The General Electric Company on April 2 completed the purchase of the stock (share capital) of the Siemens-Halske Company of America, payment being made in cash. It is proposed to continue the operation of the Siemens-Halske plant at Chicago as a western factory of the General Electric Company. It will be recalled that the Widener-Elkins syndicate bought a controlling interest in the Siemens-Halske some months ago, which interest formed part of the General Electric purchase. We learn that the Pennsylvania Iron Works Company, which was purchased by the Widener-Elkins syndicate at about the same time it bought the Siemens-Halske Company, was not included in the sale. In a press account of the deal it was erroneously stated that the American firm was practically a branch of the German Siemens-Halske Company. There was no financial connection between the two companies, all the stock of the former having been owned in the United States.

Annual Report of the American Bell Telephone Company.

The twentieth annual report of the directors of the American Bell Telephone Company shows that at the end of last year there were 1,580,101 instruments in the hands of the licensees under rental, an increase of 455,255 over the preceding year. On Jan. 1, 1900, there were 1239 exchanges, an increase of 113 over the preceding year; 1187 branch offices, an increase of 179; 509,036 miles of wire on poles, an increase of 112,000 miles; 15,087 miles of wire on buildings, a decrease of 242 miles; 489,250 miles of wire underground, an increase of 131,066 miles; 3404 miles of submarine wire, an increase of 431 miles. The total mileage of wire was 1,016,777, an increase of 243,778 miles. The total number of circuits in use was 422,620, an increase of 84,327. The total number of employees was 25,741, an increase of 6073, and the total number of stations 632,946, an increase of 167,766.

The estimated number of exchange connections daily in the United States, as made up from actual count in most of the exchanges, is 5,173,803. The number of daily calls per station varies in different exchanges from 1 to 21.8, the average throughout the United States being 8.2. The average cost to the subscriber by exchanges varies, according to the size of the exchange and character of the service, from less than one cent to nine cents per connection.

The average daily number of toll connections is 132,884. The total toll revenue reported by all companies for 1899 (not including the earnings of the American Telephone & Telegraph Company) was $7,275,835. The extra-territorial and toll lines comprise 89,292 miles, an increase of 13,574 for the year, and 501,832 miles of wire, an increase of 115,921 for the year.

The Long Distance Company had on Jan. 1, 1900, 12,006 miles of pole line and cable and 150,380 miles of wire, connecting 323 offices; a gain during the year of 1927 miles of pole line and cable, 27,105 miles of wire, and 38 offices. In all there are 39 companies whose systems furnish Bell long line terminals. These companies report a total of 557,979 stations, of which 55.76 per cent. are equipped with metallic circuit.

The report states that the year just past has been the most noteworthy of any in the business, in respect to the development both of the exchange and toll line systems. The increase in the number of subscribers has been more than double that of any previous year. This is partly ascribed to the introduction in certain localities of unremunerative rates to meet similar rates set up by competitors, but it is believed in the main that the growth has been healthy and will be permanent.

Large extensions of the properties of the operating companies have been made during the past year, and the construction has been of high standard. More than one hundred and fifteen thousand miles of toll line wire have been added, the larger proportion being of copper, and upward of two hundred and forty thousand miles of exchange conductors, more than half of which was put underground.

The work of equipping the large exchanges with central energy switchboards is going forward rapidly. More than 60 per cent. of all the exchange stations in the United States are now connected by metallic circuits.

The new construction completed in 1899 by companies operating under Bell licenses amounted to $24,036,822.59. Of this sum $15,949,463.32 was expended upon exchange construction and equipment, and $8,087,359.27 upon toll lines. In addition to the above, $2,066,311.85 was invested in real estate to be utilized for exchanges and company offices. The entire expenditure for construction, including real estate, to the close of last year has been $137,262,443.70.

As stated above, at the close of last year, the subscribers connected with exchanges of the licensee companies numbered 632,946. The latest reports that can be obtained, most of which are for the year 1898, show the countries next in order, as respects the use of the telephone, to be the German Empire, having 212,121 exchange stations; Great Britain, 112,840; Sweden, 63,685; France, 44,865; Switzerland, 35.536; Russia, 26,865; Austria, 26,664, and Norway, 25,376, the aggregate of stations in all these countries falling well below the number in our own country.

Following are the ledger balances, Dec. 30, 1899:

DEBTORS.

Telephones	$3,488,850.38
Real estate	1,271,961.42
Stocks	70,975,500.00
Merchandise and machinery	23,846.26
Bills and accounts receivable	9,272,336.31
Cash and Deposits	584,953.20

CREDITORS.

Capital stock	$25,886,300.00
Capital stock premium	6,110,582.00
Debenture bonds, 1898	7,500.00
Debenture bonds, 1908	10,000,000.00
Bills payable	4,214,557.67
Patent account (profit and loss)	12,345,973.16
Profit and loss	19,148,943.10
Reserves	4,928,513.39
Surplus	2,975,078.25
	$85,617,447.57 $85,617,447.57

Of bills payable $1,164,883.50 was for the dividends payable Jan. 15, 1900, to stockholders of record Dec. 30, 1899.

Following is a comparative statement of earnings and expenses:

EARNINGS.

	1898.	1899.
Rental of instruments	$1,610,855.64	$1,714,526.54
Dividends	3,239,406.58	3,809,504.02
Commission from Ex.-Terr. lines	121,511.07	
Commission from Teleg. business	18,389.20	
Real estate	83,864.92	84,692.50
Interest	370,991.58	149,434.40
Miscellaneous	3,682.50	1,948.99
	$5,448,701.49	$5,760,106.45

EXPENSES.

Expenses of operation	$509,673.90		$591,826.34
Legal expenses	94,226.62		103,748.46
Real estate	40,235.09		42,407.39
Miscellaneous	1,747.42		20,479.59
	$645,883.03		$758,461.78
Net earnings	$4,802,818.46		$5,001,644.67
Interest paid	$187,988.02		$404,762.30
Taxes	220,863.63		523,932.96
Balance	$4,393,966.81		$4,072,949.41
Surplus account, Dec. 31, 1898		$2,785,073.84	
Balance of earnings, 1899		4,072,949.41	
			$6,858,023.25
Regular dividends, 1899		$3,106,356.00	
Extra dividends, 1899		776,589.00	
			$3,882,945.00
Surplus account, Dec. 30, 1899			$2,975,078.25

The Long Distance Company had invested, up to Dec. 31, 1899, in line construction, franchises, equipment and supplies, $17,118,509.78. The company shows an increase in gross earnings in 1899 over 1898 of 27 17-100 per cent., the amount for 1899, gross, being $2,805,012.29.

The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City—II.

By J. E. Woodbridge.

THE ELECTRICAL GENERATORS.

THE eleven dynamos are each rated at 3500-kw, a capacity greater than that of any machines previously built, with the exception of the Niagara generators, which are rated at 5000-hp each, or 3750-kw. The Metropolitan machines will, however, stand an overload of 33⅓ per cent. for four hours, this overload giving them an actual carrying capacity of nearly 5000-kw. The engines which drive them are, as noted above, able to deliver this power continuously. No such power can be obtained from the Niagara units, as they are driven by water wheels, the rating of which is based on a gate opening nearly equal to the maximum, so that they will not carry an overload of more than about 10 per cent. The Niagara machines have also a greater armature reaction. The Metropolitan machines are therefore in a sense the most powerful in the world.

The structure of these machines is of interest on account of their unusual size. They are, of course, of the revolving-field type, with external stationary armatures. The field ring is mounted on a spider consisting of eight arms cast in one piece with the hub. This casting is keyed to the 37-inch compressed steel forged shaft by means of two large keys, 5 inches by 2½ inches, spaced 90 degrees apart from each other. This arrangement is indicated in the drawings of these machines, Fig. 4. To prevent any great rush of power from the fly-wheel rim to the field ring from passing through the shaft and causing great strains on the keys, the fly-wheel hub is bolted to the spokes of the field-ring spider by 16 2½-inch bolts at a distance of four feet from the center of the shaft. The arrangement of the bolt holes in the spokes of the spider is also indicated in the drawings. The casting for one of these spiders is shown in Fig. 5, as it came from the mold in the foundry of the General Electric Company at Schenectady, N. Y. Provision for

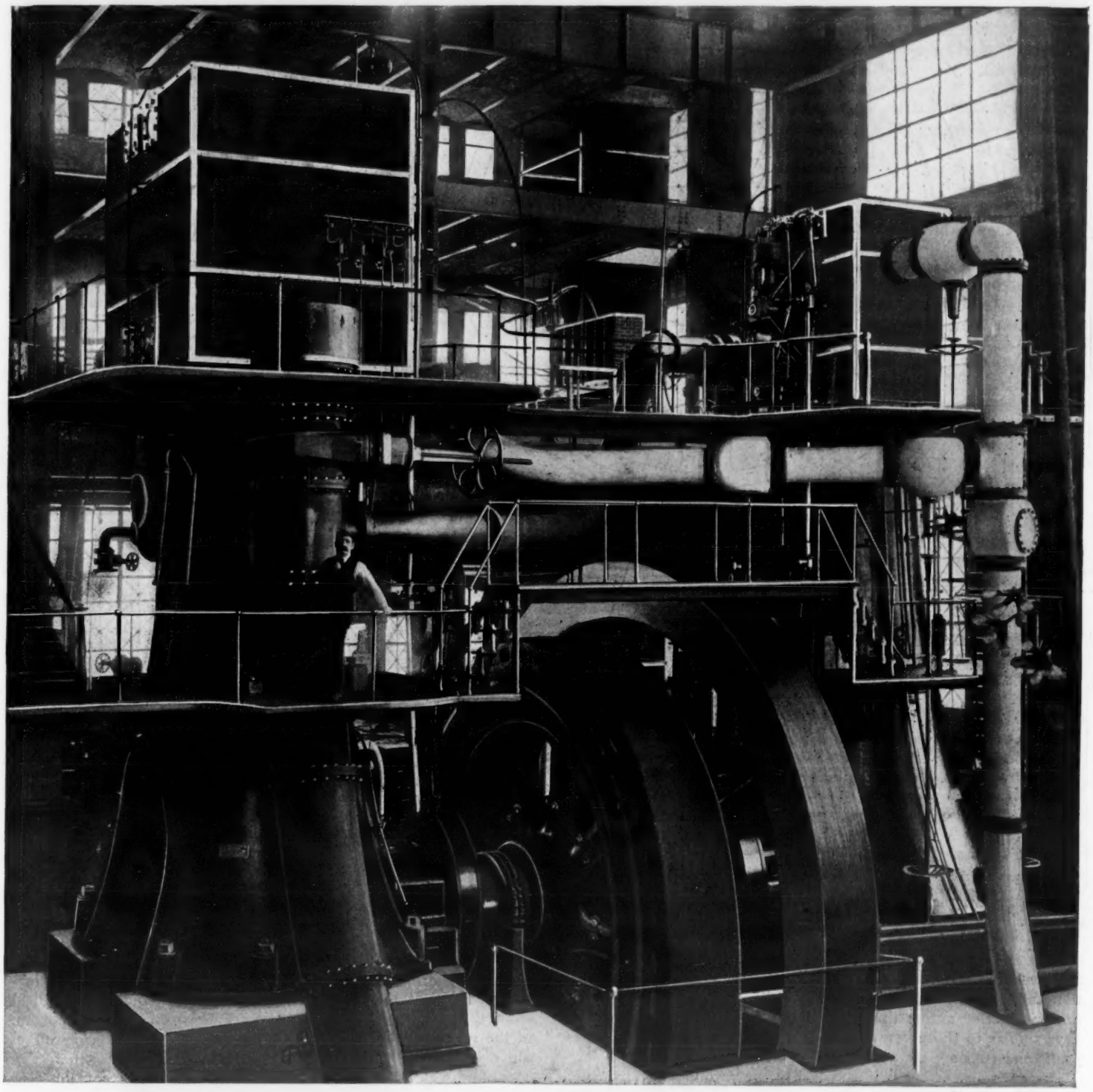


Fig. 3.—One of the 3500-kw Generators and its Driving Engine.

the bolt holes is plainly evident in this casting. In order to give the desired frequency of 25 cycles per second at the speed of only 75 r. p. m. each machine has 40 poles made up as usual of sheet-steel punchings surrounded with an edgewise winding. The diameter at the air gap is 16 feet 8 inches, giving a peripheral velocity of 3900 feet per minute. The poles are, as is usual in General Electric revolving-field machines, bolted to a cast-steel yoke ring, which in turn is bolted to the spokes of the cast-iron spider. On account of its unusual size this yoke ring is of special construction, being built up of four sections, each half the full axial width of the ring, voltage from the armature (6600 volts) at full non-inductive load being 300 amperes.

Although close regulation is not necessary in machines designed to supply rotary converters, as the power factor of the load can be kept with ease at any desired value, there was a regulation specification in the order for these machines. To meet this specification and still avoid the risk which would be incurred by giving the machines very stiff fields and consequently a heavy overload capacity, the magnetism has been carried fairly high on the saturation curve and the air gap has been made quite narrow.

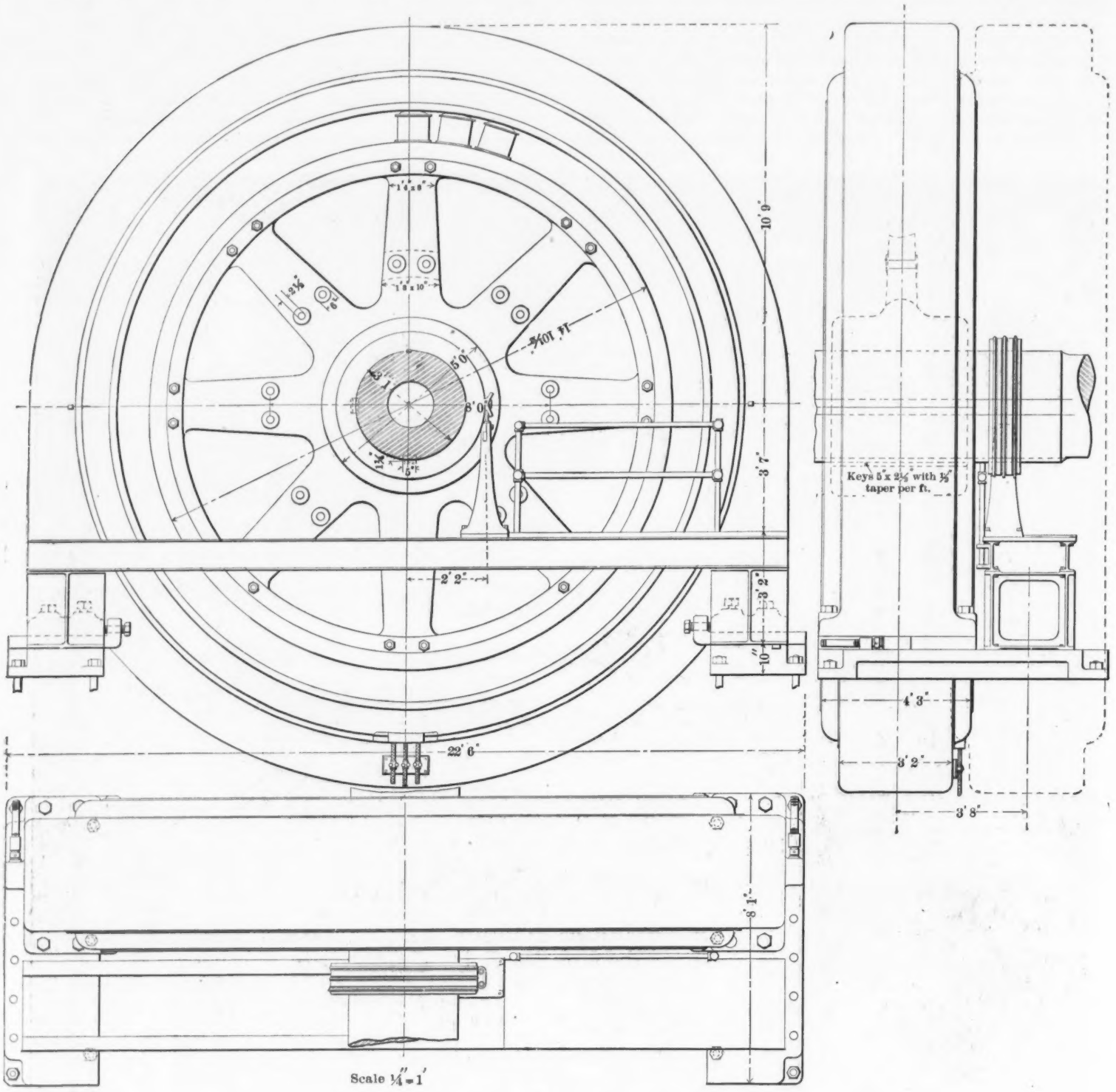


FIG. 4.—PLAN AND ELEVATIONS OF THE 3500-KW MACHINES.

and each spanning half the circumference as indicated in the section through the machine, Fig. 8. The rim tension of these sections is carried across the butt joints by means of double-headed keys similar to those commonly used in fly wheels. One of these joints and keys appear in the section, Fig. 8.

The exciting current is introduced to the revolving field through carbon brushes bearing on cast-iron rings, which are split so that they can be removed if necessary. The resistance of each field is ⅓ ohm, the necessary amount of exciting current to deliver full Working at a high density, the magneto-motive force of the armature reaction is unable to cause as great a change of the field strength, as it would if the density were down on a steeper portion of the magnetization curve. On this account the throwing off of full non-inductive load causes a rise of voltage of only 5 per cent. above normal 6600 volts. The necessary field current for 6600 volts varies from 275 amperes at no load to 300 amperes full load non-inductive, the percentage change of the field current being greater than the percentage rise of armature voltage on throwing

off full-load current, because the latter runs the magnetism up to a higher density. The pressure applied to the field terminals at full non-inductive load is obviously 100 volts, as the resistance of the field winding is one-third of an ohm and the current through it is 300 amperes. This gives a margin of 25 volts of the 125 generated by the exciters for overcoming the increased armature reaction due to lagging currents.

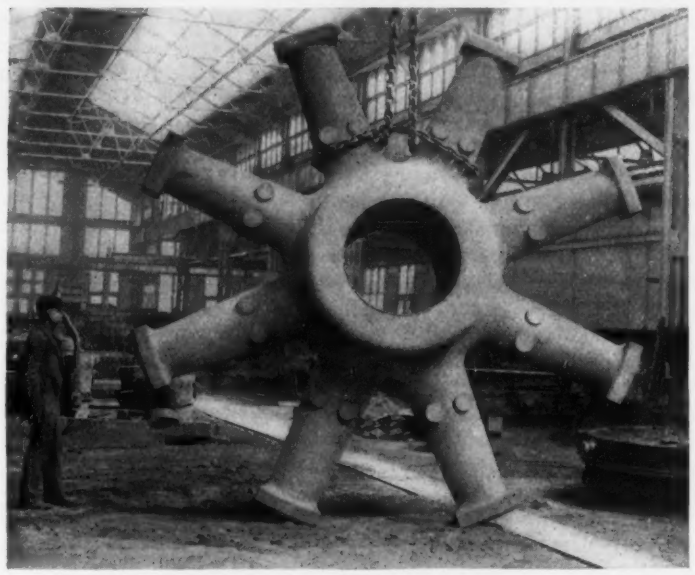


FIG. 5.—CASTING FOR REVOLVING FIELD SPIDER. WEIGHT OF CASTING, 37,600 POUNDS.

The narrow air gap reduces the number of necessary field ampere turns, to which the armature short-circuit current is directly proportional, thus cutting down the latter. The short-circuit current of each of these machines with full-load excitation, is less than 800 amperes per leg, the rated full-load current being slightly over 300 amperes. The air gap varies from five-sixteenths of an inch at the pole center to eleven-sixteenths at the tips. Fig. 9 gives the no-load saturation curve.

The frame of the outside stationary armature is of the usual hollow cast-iron type, with an external diameter of 21½ feet, and is mounted as usual on sliding foundation plates so that it can be moved axially to clear the field. On account of the high potential at which the armature currents are generated—6000 to 6600 volts three-phase—the winding is carried in a few large slots per pole rather than a large number of small ones. There are six slots per pole, each about 1¼ inches wide by 3¾ inches deep. These slots contain form-wound coils—two per pole per phase—made up of copper cable, the ends of all coils of two phases being bent back to clear those of the third phase in the usual overlapping style, making what is termed the double-chain winding. The connections are such that the armature has all the turns in each phase in series with each other, the three phases being Y-connected. There is mounted in one of the switchboard galleries a 300-kw step-up

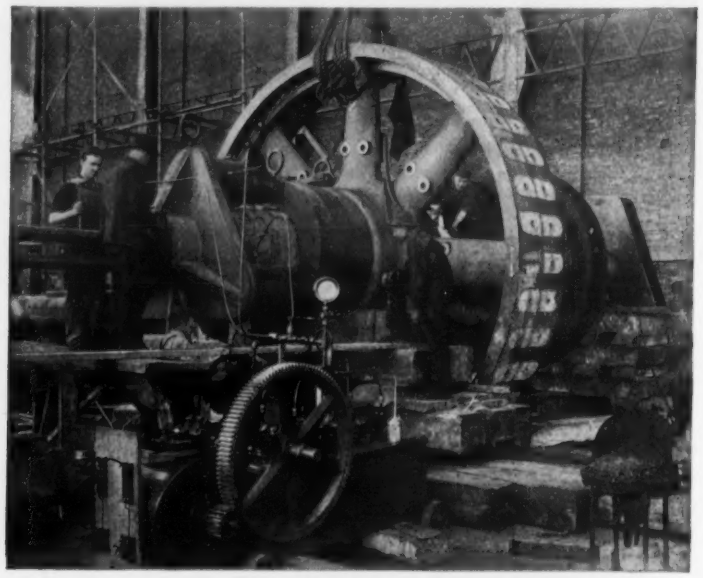


FIG. 6.—FORCING FIELD SPIDER ON TO 37-INCH SHAFT BY HYDRAULIC PRESSURE.

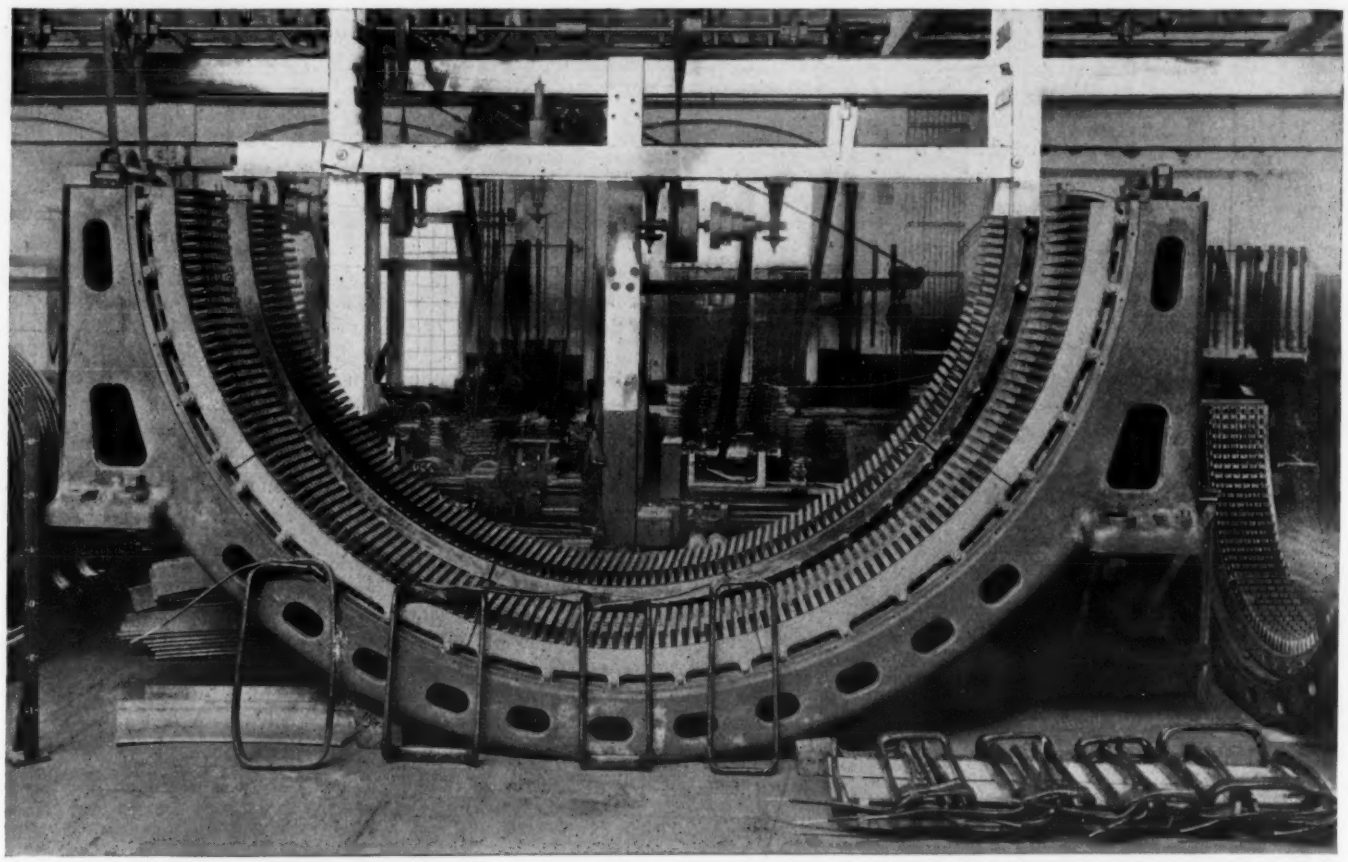


FIG. 7.—ARMATURE OF ONE OF THE GENERATORS. VERTICAL SCALE TO LEFT IS 7 FEET HIGH.

transformer, giving 20,000 volts with which to test the insulation of the armature windings of the machines, as well as the other parts of the high-potential circuits before they are put in service.

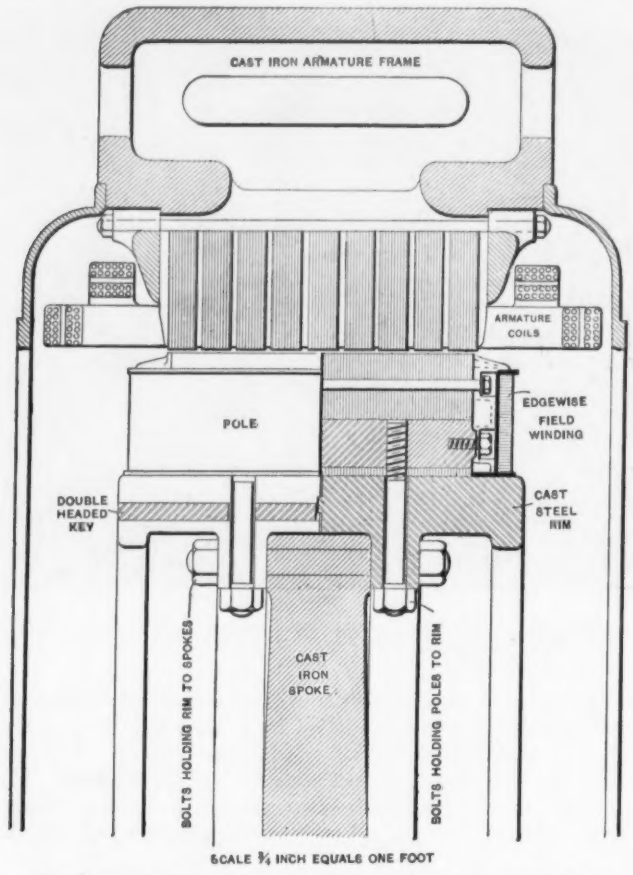


FIG. 8.—AXIAL SECTION THROUGH FIELD AND ARMATURE.

The armature copper loss at rated load is 26½-kw. The core loss of the machine is, of course, a difficult point to determine in a large machine of this kind, but has been estimated at between 1½ and 2 per cent. of the rated output. Calling it 1¾ per cent., or 62-

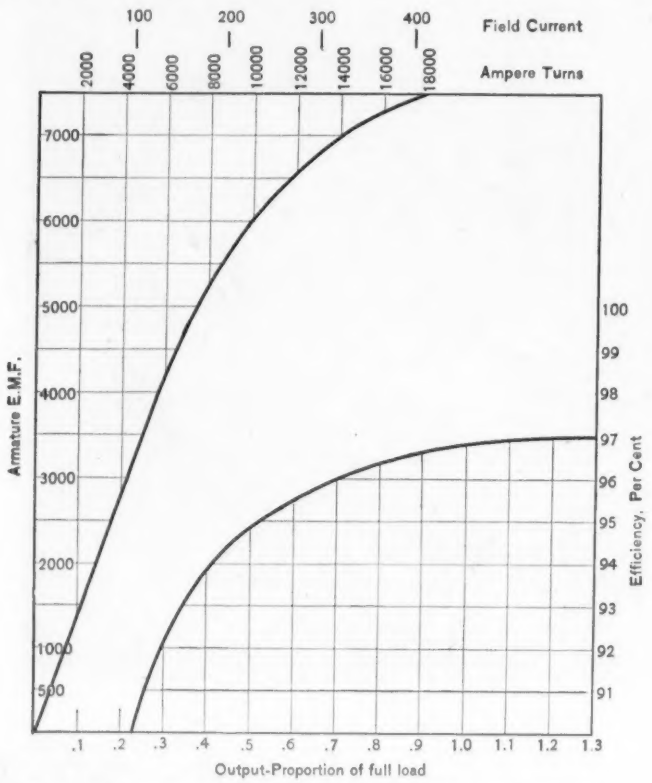


FIG. 9.—EFFICIENCY AND NO LOAD SATURATION CURVES.

kw, the efficiencies shown in the curve, Fig. 9, have been worked out. The efficiencies at various loads are as follows: 1¼ load, 97.0 per cent.; full load, 96.7 per cent.; ¾ load, 96.2 per cent.; ½ load, 94.8 per cent.; ¼ load, 90.8 per cent. The weight of each complete machine is about 130 tons, of which the rotating part weighs almost exactly one-half.

Coventry, England, Electric Railway System.

WHILE English municipalities are at length awakening to the advantages of electric tramways, it is somewhat amusing to read in the report of the United States consul at Liverpool that the city authorities are constructing an "experimental" line two and a half miles in length. English conditions differ somewhat from those in the United States, but as far as the traffic is concerned, crowded cities and shortness of tracks offer opportunities for remunerative business which would be eagerly seized by American promoters.

Attention has been drawn to the favorable working of several street railway enterprises equipped by the British Westinghouse Electric & Manufacturing Company, such as those in the cities of Plymouth, Coventry, Norwich, Hull and Bristol, and it has led to extensive contracts being made by them with other corporations, among them Glasgow, Darwin, Willeston, Southford, Manchester, Halifax, St. Helens and Southampton.

The history of the Coventry electric tramways is a record of financial success from its inception. Formerly a steam tramway, it fell into a receiver's hands, and was purchased by the present company. Early in 1896 an electrical equipment was substituted for the steam locomotives, and recently the lines have been greatly extended and the electrical equipment doubled. The town of Coventry has a population of between 50,000 and 60,000 and is one of the most ancient in the central counties, its history going back to the time of the celebrated Lady Godiva, who lived before the Norman conquest.

The original line, completed in December, 1895, comprised 5¾ miles of single track, extending from the railway station northward through the main streets of Coventry and the suburbs to the village of Bedworth. The original power station was situated at Foleshill, but this has been abandoned, and a new generating station and car sheds built at Priestley Bridge, from which the entire system is worked. Extensions of track have been made; one of them leads to Bell Green to the northeast, and two other lines, passing through different streets, meet again at Gosforth Green, from which there is a line to Lower Stoke. The present total length of the entire system is 10½ miles, and as there are over two miles of double track, the total length of track is 12¾ miles. The change along the route to Bedworth, where the line has been in operation for some time, is particularly noticeable, as an appreciable impetus has been given to building operations, and the idea that an electric railway depreciates property is again effectually dissipated.

The permanent way of the older portion of the line is laid with girder rails of 84 pounds on six inches of concrete, with a top dressing of sand, the usual 18-inch margin being paved with granite, the gauge being 3 feet 6 inches. There are few sharp curves on the old line, but several gradients, one of them 180 feet in length reaching one in twelve. The permanent way of the new lines would seem unusually light for street railways were it not for the welding of the joists, coupled with the low rate of speed of cars enjoined by the English Board of Trade. The rails for the new section are 65½ pounds, in 45-foot lengths, resting on steel sleepers with clips ten feet apart, which hold the rails to gauge at the base. Tie rods are also placed at intervals of ten feet, and near the head of the rails to amply secure alignment. The sleepers are bedded in a six-inch concrete foundation, in which, outside the rail, are laid Doulton's conduits for the feeder cables. Above the concrete is a one-inch layer of fine sand, on which the granite paving sets are laid. All the rail ends of the new tracks have been cast welded on the Falk system, so that there is no break throughout the tracks. The cast-welded joints are about 14 inches in length, weighing from 70 to 140 pounds, producing a strong mechanical joint with an electrical conductivity usually greater than that of an equal length of rail, and always far higher than that of the ordinary bonded joint. Welding provides a stronger and more durable joint, requiring less frequent disturbance of the roadway for repairs, and it affords smoother riding and diminishes the noise of the cars.

The site of the power plant is at Priestley Bridge and is nearer the geographical than the load centre of the system. The engine room is parallel with the boiler room, divided from it by a wall.

The boiler plant consists of four Babcock & Wilcox water tube boilers, two of 172-hp and two of 106-hp, working at 120 pounds pressure. The boilers are fitted with mechanical stokers and an endless chain conveyor. Feed water is taken from the adjacent Coventry Canal or from the city mains by three Worthington pumps, each capable of feeding three boilers. The water is passed through a heater and two separators, and thence flows to a Green economizer of 240 tubes which has been erected in an extension to the boiler room, and is so arranged that the furnace gases may be passed through it, or by-passed directly into the stack, the latter being of brick, 100 feet high and 6 feet 4 inches in diameter at the top. The steam piping is arranged in duplicate rings, so that any two engines can be operated from any boiler.

The condensing plant is in duplicate, each set consisting of a surface condenser of 450 square feet surface, placed in the basement of the engine room, and a pair of balanced vertical air pumps driven through single reduction double helical gearing by a steam engine.

The air pump barrels are 12¼ inches diameter, with 8-inches stroke, making 100 double strokes per minute when the engine runs at 300 revolutions per minute. A centrifugal pump is driven from the flywheel of the engine by means of a belt, and draws water from the canal at one point, circulates it through the condenser, and returns it to the canal at another point. Each set is capable of dealing with all the steam from the engines when indicating 300-hp. Although the plant is situated below the floor level, it is so arranged that every part is readily accessible, and the condenser tubes can easily be withdrawn. An automatic relief valve is provided for atmospheric exhaust in case of need.

The engine room is 80 feet in length, containing a total capacity of 600-hp. Two new engines of 150-hp each, horizontal tandem compound condensing and 250 r. p. m., are direct-connected to two 100-kw Westinghouse six-pole compound-wound generators, at 500 volts. Two engines of similar type, which were originally used at the old station, have been reconstructed and altered in design, and belt drive at 650 r. p. m. two four-pole 100-kw Westinghouse direct-current generators, which are otherwise similar to those previously mentioned. A view of the interior of the engine room is shown in Fig. 1. In addition to the traction sets, a 17-kw Westinghouse generator at 500 volts is direct-coupled to a single acting 7½x7 inch Westinghouse engine, operating at 400 r. p. m., for supplying light for the station buildings, and power for the repair shop motors, when work is carried on after the main generators are shut down.

The switchboard follows the usual Westinghouse practice, having four generator and two feeder panels, and others for the lighting circuits and for the Board of Trade tests. The panels carry the usual instruments for metering and controlling the current. The equalizer switch is combined with the circuit breaker, and a watt-hour meter is in circuit with each dynamo, behind the board, and Wurts non-arcing lightning arresters are in use.

The overhead construction presents considerable variety. Double trolley wires 0.32-inch in diameter have been used throughout. Near the station there are poles on both sides of the road with span wires; beyond, along Greyfriar's Green, side poles with short brackets are used, the track running at one side of the road. Through the narrow streets of the city the cross suspension wire is secured to buildings by rosettes. At Broadgate there is, however, a center pole with double bracket arms, as the roadway here was broad enough, and the turnout passes around the pole. Outside the town on the Bedworth line side poles and cross-wire suspension is used, and on the new route through Hall Street the trolley wires are hung from span wires attached to rosettes, but side bracket-arm poles are used over most of the route beyond. The bracket arms vary in length up to 17 feet and are placed so that the trolley wires may be hung over the centre of the tracks. The poles, 30 feet in length, are of tubular steel in three sections. Aetna insulating material has been used for trolley hangers, pull-off brackets, etc. The trolley wires are carried into both car sheds, the new one at Priestley Bridge, and into the original one at Foleshill. The feeder system, on account of the central location of the power house, is very simple in character. There are three feeders of 0.25-inch section, 300, 1900 and 1300 yards in length respectively, and one feeder of 0.05-inch in section 1200 yards in length. One feeder extends along the Coventry Canal, feeding into the trolley wires of the Bedworth line. The feeders are carried underground in the town and on poles in the open country.

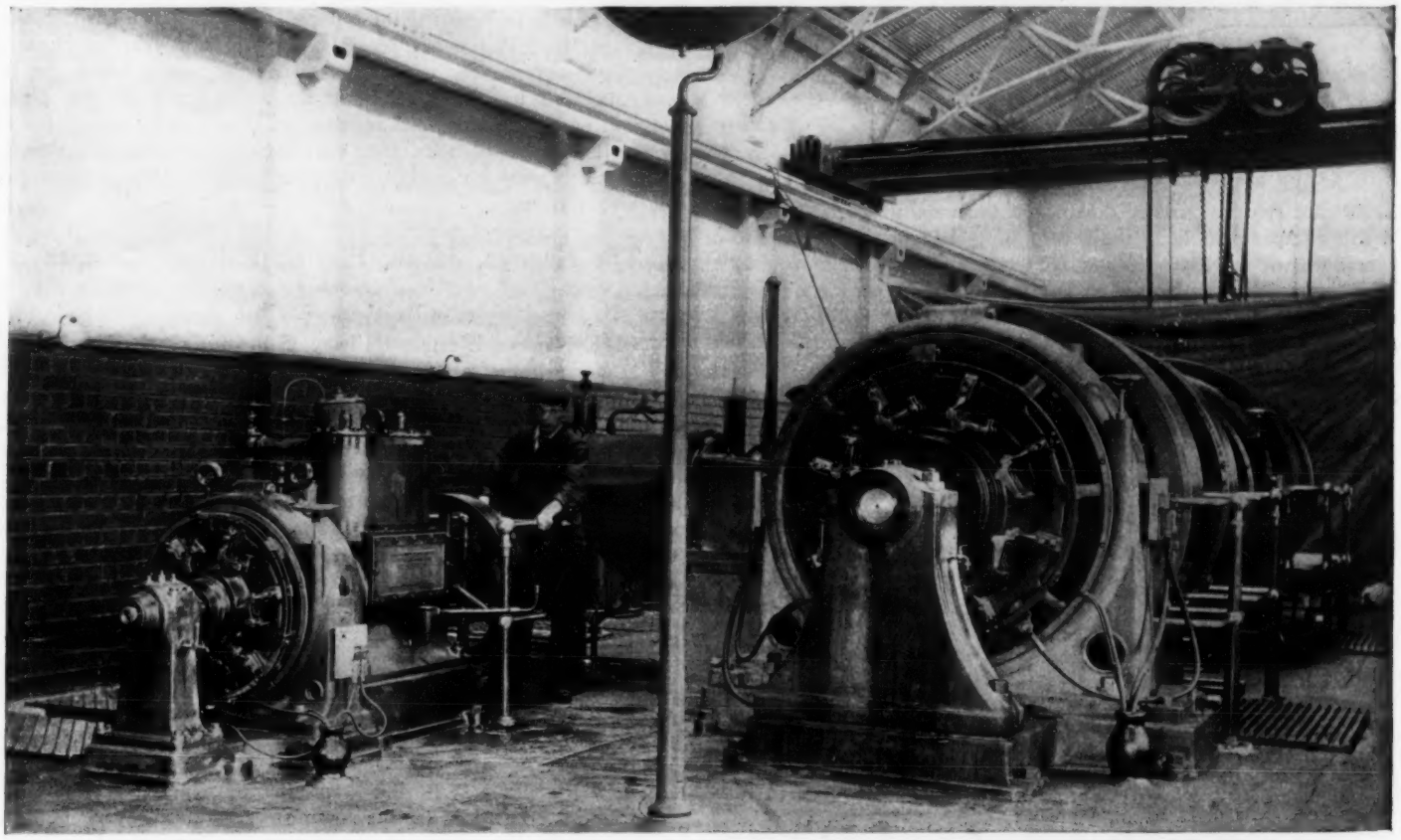


Fig. 1.—Interior of Engine Room, Coventry Electric Tramway Company.

The original car barn for the Bedworth line affords room for 15 cars. It measures 58 feet by 60 feet, and is furnished with inspection pits and a transfer table. The new car barn, shown in Fig. 3, has space for 12 cars, measuring 102 feet by 50 feet. The paint and repair shops occupy 35 feet of the entire width of the building. The inspection pits are ample, and as the rails are supported on girders resting on brick pillars without division walls, there is a

free passage from one track to another and plenty of room to work. The repair shop is at the rear of the car barn, and is conveniently fitted up with the customary repair machinery, which is driven by 5-hp and 10-hp electric motors.

A very interesting repair appliance is the Hampden car wheel grinder, manufactured at Springfield, Mass. All new wheels are put in the machine for the removal of any irregularity from the surfaces, so that a perfectly round wheel is insured. Any "flat

FIG. 2.—NEW POWER HOUSE AND CAR BARNS, COVENTRY ELECTRIC TRAMWAY COMPANY.

wheels" are at once ground down, and the machine will materially aid the company to keep their cars in good condition. A more general use of machines to remove "flats" from wheels would be highly appreciated not only by the patrons of street cars, but by those living upon the routes of electric railways. The car wheel grinder, when not in use, is lowered beneath the floor and the track left free, and when required for use it can be quickly raised; it is driven by a 10-hp motor, which also supplies power for operating a coal conveyor.

The rolling stock consists of between 20 and 30 cars of the double

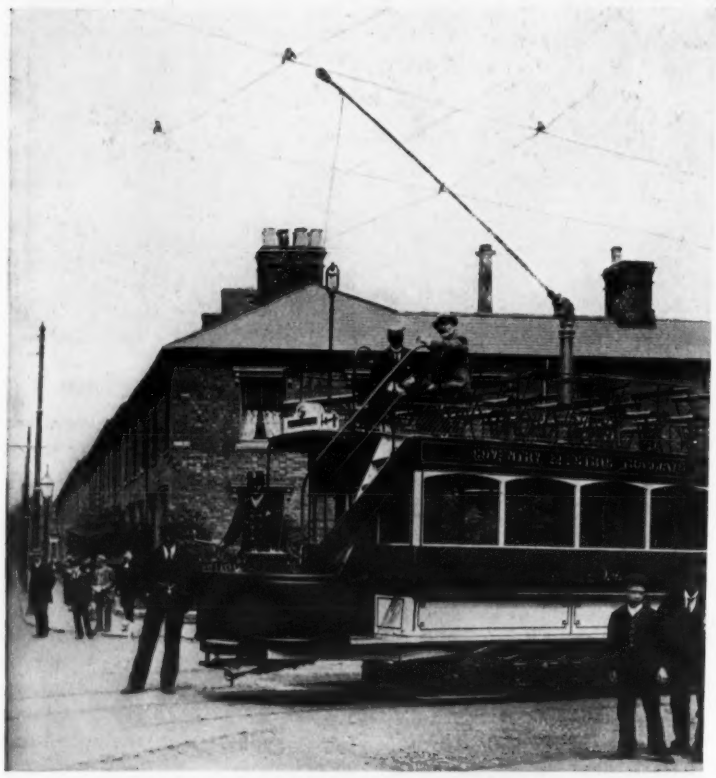


FIG. 3.—STREET CAR, COVENTRY ELECTRIC TRAMWAY COMPANY.

deck type and a few trailers of the same design. The car bodies were built by the Brush Electrical Engineering Company, Loughborough. The older ones that were in service originally measure 13 feet 6 inches in length of body, and are 5 feet 6 inches wide over all. The new cars have 18-foot bodies, and measure 6 feet in width over all.

The electrical equipment of all the cars has been supplied by the British Westinghouse Electric & Manufacturing Company, consisting of motors and controllers. This apparatus is all of the standard Westinghouse type. The weight of the smaller car complete is 5½ tons, and of the larger ones 6½ tons. The trolley, which has been designed by the resident engineer, is an interesting feature. It retains the spiral springs, but the diameter of the standard has been reduced and all the working parts are enclosed. The springs are placed in two series of four grouped about a centre but each is directly connected to a trolley pole. An even pressure, which cannot be given by a coil spring, is thus secured in whatever position the trolley pole may be. The hood at the top of the trolley standard entirely closes it and prevents the admission of any moisture. All the cars are mounted on Peckham trucks, and present a neat and attractive appearance. The destination of cars is shown on the hood of the car. At the top behind a ruby disc is an incandescent electric lamp which, beside illuminating the disc at night, also reflects down and makes the sign on the ground glass legible.

The town of Coventry may be justly proud of possessing one of the most completely equipped street railways in England. Its financial success was assured from the outset. In 1897 the company was able to pay a dividend of 8 per cent., and since then the electric cars have retained their popularity and are loaded to their full capacity. The gross receipts for the first year of electrical operation were nearly three times what they were when the line was operated by steam. The great convenience to the public, coupled with these financial results, led to a general desire for the system to be extended to other parts of the city, and with this end negotiations were successfully completed between the company and the corporation.

The Nagoya, Japan, Electric Railway Company.

BY PROF. T. KOGI.

THE Nagoya Electric Railway Company received a franchise for a horse railway in the year 1895, towards the end of the war with China. In the earlier part of 1896, after a hard struggle during the great panic in the financial market which occurred immediately after the war, the company took a new start, remodeled its organization and with increased capital proceeded to change the horse system to electric traction. This change of motive power was approved by the Government May, 1896, and the company was granted the right to put an electric track on the main street from the railway station of the Tokaido line (belonging to the Government) to the local government building at the end of the same street; also on the road to Atsuta, the seaport of Nagoya, which crosses the main street. Besides these two lines, there is now building an interurban road to Biwajima, about two miles distant, a distributing centre for vegetable products. The whole length of track will aggregate about twelve miles, including double tracks, siding, etc.

The work was first started March 18, 1897, and traffic was commenced May 6, 1898, on the main street section over about one and three-fourths miles of double track. The Biwajima section is now in course of construction and will be ready to be opened next spring.

The whole system is based entirely on American practice, and was designed by the writer, who during a year's residence in America made himself familiar with the latest practice in American power house design and street railway operation.

The power house equipment consists of two Sterling water-tube boilers, each of 150-hp; an iron smokestack 54 inches in diameter at the top and 100 feet high; two Philadelphia Corliss engines, made by the Philadelphia Engineering Works, each 10 inches by 18 inches by 24 inches, and running at 140 r. p. m.; two Walker 100-kw six-pole electric railway generators, belted to the above engines and running at 550 r. p. m.

The engines are run condensing in connection with a Worthington jet condenser. The boiler feed water is heated by means of a Goubert feed-water heater, which utilizes the exhaust steam from the feed pump and condenser. Stratton steam separators with Bundy steam traps are fitted for both engines.

The switchboard is also of American make, having been supplied by the Walker Company, and consists of two generator panels and two feeder panels on which are mounted three sets of instruments for three feeders. All the instruments used are of the Weston round pattern.

The present location of the power house is about half a mile dis-

tant from the track, and over this distance a single set of insulated feeders is run overhead. The insulated wires are partly John A. Roebling's Sons "Crescent" and partly New York Insulated Wire Co.'s "Raven core" brand. The trolley wire is hard-drawn copper wire of No. 0 B. & S. gauge, supplied by Washburn & Moen, San Francisco. The overhead construction material was bought from the Ohio Brass Company, through their agent in Yokohama, except the porcelain material, which was made very cheaply in the neighborhood of Nagoya. The trolley wires are all hung from span wires supported by wooden poles erected along the curb line of the streets.

The car bodies were built some in Toyko and some in Nagoya, the size being six feet wide by twenty feet long, including platforms at both ends. All the cars are of the closed type, and seat forty passengers. The trucks are all Peckham, specially made for 3 feet 6 inch gauge and single motor equipment, with a short wheel base of five feet for ease in turning curves on short radius. The motor equipments are all Walker, of 25-hp maximum capacity.

There are now fifteen of these cars running on the road. The company is said to have placed the order for fifteen more equipments, to arrive next spring, and to be used for the interurban extension. With these the two sets of engines and generators will be brought up to full load and their earning capacity thus made a maximum.

Fifty-pound T-rails are used for all tracks, with proper guard rails and pavements at street crossings and turnouts. The fish plates weight 18 pounds per pair. The rail-bonds used are what are known as Chicago bonds, with a cross sectional area equivalent to No. 00 B. & S. Every other bond is cross-connected and joined to a supplementary wire laid close along the inside rails of double track.

The "section fare" system is used. The lines (about 1¾ miles) are divided into four sections, and the fare is one sen a section—one sen being nearly equivalent to ½ cent.

At present the gross earnings average about 120 yen a day ($60 United States gold), against total running expenses of 60 yen. The net profit is thus rather a good showing for such a short and experimental line.

The prospect for the near future when the system is completed, and with a traffic increasing with the general growth of the town, is that the enterprise will become one of the best paying corporations in the country, which is supported by the fact that the stock quotation of this company is always 20 to 30 per cent. above par. The capital of the company is 500,000 yen, of which 262,500 yen were paid up the end of last July.

The Electrical Industry in Italy.

In the past few months there has been a remarkably large number of national and foreign companies organized for electrical undertakings in Italy. The Societá Per Le Tramvie Elettriche Di Terni was incorporated about the end of November, with headquarters in Rome, with a capital of 1,000,000 lires, entirely subscribed, and three-tenths paid in. The business will be the installation and operation of an electric railway from Terni to Valle del Nera, together with other electric undertakings near Terni. The Societá Delle Tramvie e Ferrovie Elettriche was incorporated on December 1, with headquarters in Rome. The subscribed capital is 1,500,000 lires, of which three-tenths is paid in; the capital may be increased up to 15,000,000 lires. The company will install and operate a network of electric railways from Rome to neighboring towns. It is reported that the first project which this company contemplates executing are the substitution of electricity for steam on the Roma Frascati Railway (length about 15 miles) and the installation of an electric railway from Rome to Ostia (length about 20 miles); the latter will afford connection between Rome and the sea. The president is Count Carlo Rasponi, and director, Mr. Roberto Cavallini.

The Societá Anonima Di Costruzioni Elettriche, Brioschi, Finzi & Co., was incorporated on December 3 with headquarters in Milan. The paid up capital is 1,700,000 lires, which may be increased up to 2,500,000 lires. This is an enlargement of the existing firm of Brioschi, Finzi & Co., and it proposses to continue the construction of electrical machinery for continuous and alternating currents. The Societá Italiana Di Elettricitá Alioth has been incorporated with capital of 300,000 lires to operate electrical undertakings in Italy. The Compagnie D'Electricite Thomson-Houston De La Mediterranee has opened an office in Milan, and with a capital of 500,000 lires for electric undertakings in Italy. The Unione Telefonica Lombarda was incorporated in Milan, with a capital of 350,000 lires, and will engage in the telephonic industry. The first lines to be installed will be those connecting Milan with the neighboring towns. The Societá Anonima Di Electricitá Umbra is a branch of the Siemens & Halske Company, of Berlin, and its object is the operation of an important electric lighting and traction plant, installed by the latter firm in Perugia. The capital is 1,200,000 lires. The Societé Generale Des Tramways Et Chemins De Fer Du Centre has been incorporated, with headquarters in Naples, with a capital of 1,250,000 francs, and will construct and operate electric railways. A license has already been asked for a line between Naples and Piedimonte.

A Means of Fixing the Frequency of Inverted Rotaries.

ROTARY converters are now coming into use for the transformation of power from the direct-current form to the alternating-current form, as well as for the much more common case of transformation in the opposite direction. Cases of this kind occur when it becomes desirable to supply a limited alternating-current service from a large direct-current central station without putting in separate engine-driven generators. In some large Edison systems, notably those in New York City and Chicago, the direct-current busbars, several miles apart, are paralleled through rotary converters, transformers and high-tension polyphase transmission lines over which the power is sometimes carried in one direction and at other times in the other direction. Other cases of this rather unusual use of converters occur when it becomes desirable to supply a small suburban electric-railway extension with power from a large direct-current power

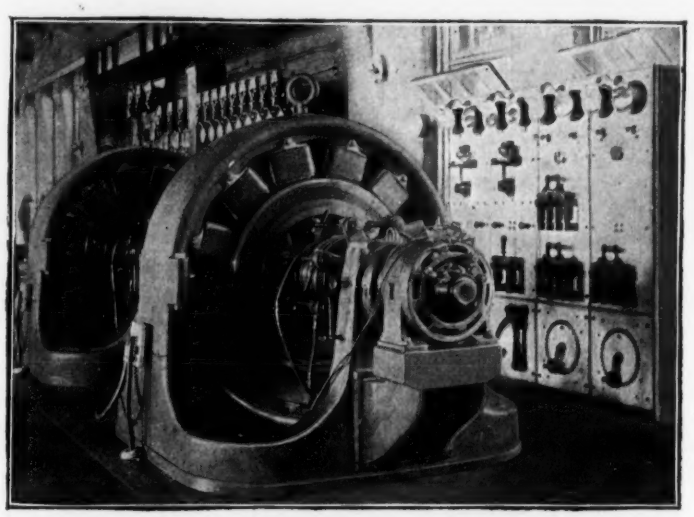


FIG. I.—PAIR OF INVERTED ROTARIES WITH EXCITERS.

station. In some cases of this kind it is considered preferable to take the power from the busbars rather than to install a generating equipment of a totally different type from that already in use and not capable of running in parallel with it. A rotary converter when used in this way to absorb power from the direct-current lines and deliver it to the alternating-current lines has been termed an "inverted" rotary converter.

When rotaries are worked in the ordinary way, absorbing power from alternating-current lines, their speed is determined by the governors of the prime movers driving the alternating-current generators, with which the rotaries must run in synchronism. When run as inverted rotaries not in parallel with any alternating-current machines driven by prime movers, there is no such determining factor of the frequency and speed, and this involves an unusual difficulty. The speed and hence the frequency of an inverted rotary, depend solely upon the impressed direct e. m. f. and the field strength of the machine, since it is working—so far as its direct-current side is concerned—purely as a shunt motor. If the field is weakened the machine will run faster, giving a higher frequency, and conversely if the field is strengthened the machine will

run slower, giving a lower frequency. Unfortunately, the field strength is not dependent solely on the adjustment of the field rheostat, but is interfered with by any leading or lagging alternating currents that may be set up by the condition of the loop and circuits supplied by the machine. If the load upon the rotary becomes reactive, the lagging currents react upon its field, weakening it and forcing the machine to run faster as a direct-current motor, in order to give a sufficiently high counter e. m. f. to oppose that impressed upon it from the direct-current source of supply. If the high-tension lines supplied by the inverted rotary have a high capacity, or, for any other reason, the currents forming the output of the inverted rotary lead the impressed voltages, the field strength of the inverted rotary is increased, slowing the machine down and reducing the frequency. The armature reaction of a rotary with heavy lagging currents is often so great as to cause the machine to rise to a dangerous speed. Even if the load is always sufficiently non-inductive to avoid this danger, the alternating-current frequency is dependent upon the power factor of the load, a very unsatisfactory condition in the practical operation of such machines.

An ingenious means of overcoming this difficulty has been worked out by Mr. B. G. Lamme and has been applied in several instances by the Westinghouse Electric & Manufacturing Company. Briefly this means consists of supplying the field winding of the inverted rotary from an exciter driven by the rotary itself. In case the speed of the machine tends to rise, due to a lagging load, the voltage of the exciter builds up, increasing the field excitation of the inverted rotary and checking the rise. In case the speed of the set goes down, the exciter voltage goes down, weakening the excitation of the field of the inverted rotary and checking the drop. The exciter is a shunt-wound machine, and is normally worked with its field density well below the bend of the saturation curve, making its voltage extremely sensitive to very small changes in speed. If the speed rises 1 or 2 per cent. the exciter voltage instantly goes up correspondingly, the shunt field of the exciter gets more current, still further increasing the exciter voltage, causing a further rise of the field current, etc., the action being cumulative until the bend of the magnetization curve is reached, provided the speed remains above normal. If the speed runs down a few per cent. the field of the exciter gradually dies out entirely, unless the speed is restored. Thus any variation of the speed of the inverted converter causes the voltage of its exciter to begin to change, this change continuing until the speed of the rotary is brought back to normal by the change of its field strength.

In equipments designed to make use of this principle, the exciter is, as a rule, direct-coupled on the end of the rotary shaft in very much the same way as induction motors are direct coupled to the shafts of similar machines for starting purposes. A view of a pair of inverted rotaries with exciters is shown in the accompanying half-tone illustration, these machines being in service in the power station of the Union Railroad Company, Providence, R. I. They are 300-kw machines supplying a pair of 250-kw rotaries in a substation 14 miles distant, this substation delivering direct current to a suburban extension trolley line. A general diagram of

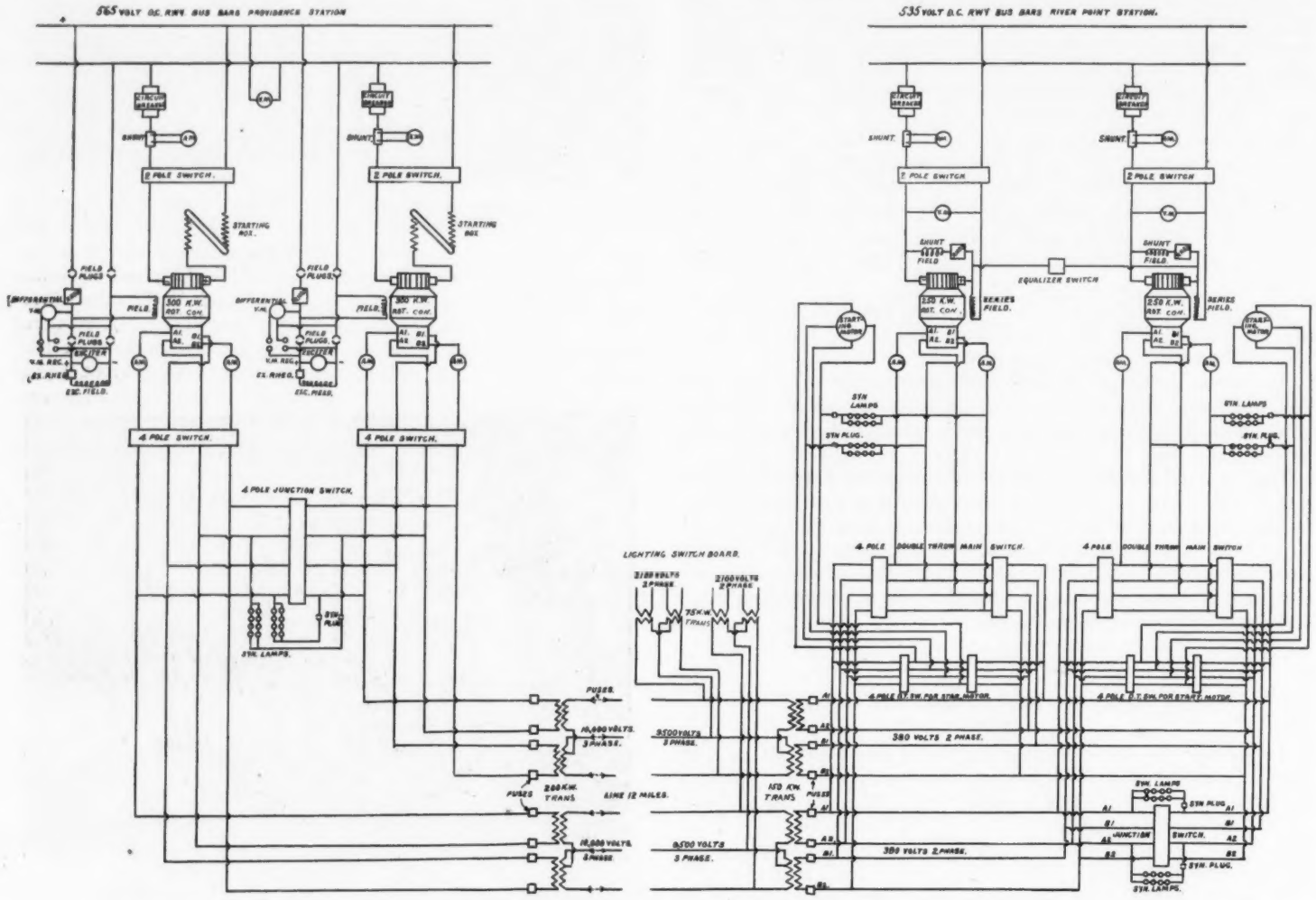


FIG. 2.—DIAGRAM OF COMPLETE CIRCUITS.

the complete circuits is shown in the accompanying line illustration. At the upper left-hand side may be seen the direct-current busbars of the railway power station. Each of the two 300-kw inverted rotary converters takes its power from these busbars through the usual instruments, a starting box being provided to bring it from standstill up to speed in the usual way. In starting one of these inverted rotaries its field is first excited from the railway busbars by pushing in the pair of field plugs, shown uppermost in the diagram. A rheostat is included in the circuit to bring the voltage impressed on the field winding down to that for which it is wound, viz., 250 volts. The inverted rotary is then started up as a direct-current motor by means of the starting box connected in its armature circuit. When it has approximately reached its normal speed of 600 r. p. m. the voltage of its exciter is built up to the pressure impressed on the field of the rotary. By pushing in the lower pair of field plugs the exciter is closed on the field of the rotary, in parallel with the bus-bar supply, the rheostat in the bus-bar connection remaining outside the circuit from the exciter to its load. By pulling out the upper pair of field plugs the field of the rotary is left in charge of the exciter alone, with no rheostat be-

tween the two. The speed and frequency of the rotary are then adjusted by means of the rheostat in the field of the exciter.

The alternating voltage is, of course, determined by the direct-current bus-bar voltage. As the exciter is working at a very sensitive point on its magnetization curve, it is obvious that any slight drop of speed will cause its voltage to gradually die down, as noted above, until the field of the rotary becomes so weakened by the fall of the exciter voltage that the speed returns to normal. Conversely, if the speed of the rotary goes up slightly, the voltage of the exciter begins to build up until the field of the rotary becomes strengthened sufficiently to return the speed to normal. Thus the sensitiveness of the unsaturated shunt-wound exciter to the slightest changes of speed, and the consequent wide changes of exciter voltage that follow the slightest changes of exciter speed, check the variation of the rotary from normal speed to a very low figure. In case a heavily reactive load is drawn from the collector rings of the inverted rotary the speed drops slightly, the exciter voltage begins to build up, and continues to do so until the field winding of the inverted rotary gets sufficient current to overcome the demagnetizing reaction of the rotary armature. When this point is reached the speed of the inverted rotary returns to normal and the increase of voltage of the exciter is checked. The action is closely similar to that of an automatic field rheostat, having a magnet which throws into action a pawl or clutch or plunger, to vary the field resistance continuously until normal voltage is restored. The limit of the action, in case of excessive lagging loads, is only reached when the exciter field strength reaches the bend of the saturation curve. If the lagging currents become so great as to call for more field excitation than is given by the exciter at the saturation bend, the speed will rise, the change becoming greater per ampere of lagging current as the exciter magnetization rounds the curve. Owing to the powerful fields and small armature reaction of Westinghouse rotary converters this arrangement with them easily provides for extremely large lagging loads, nearly equal in volt amperes to the rated capacity of the machine.

It will be noticed from the diagram that there is a junction switch between the alternating-current circuits of the two machines, and that synchronizing lamps are provided by means of which the machines may be brought together and paralleled. The division of the load is adjusted by varying the field rheostats of the exciters. Weakening the field of one—when the machines are in parallel on the alternating side—causes the corresponding inverted rotary to tend to run more rapidly, causing it to take more of the load and thus relieve the other machine, just as one of a number of mechanically-driven alternators in parallel takes more of the load when its prime mover gives it more power and hence tends to drive it further ahead. The step-up transformers are arranged with their secondaries on the Scott connection to give 10,000 volts three-phase for line transmission. Similarly in the step-down substation the transformers are connected to give two-phase currents to the rotary converters. Four 75-kw transformers take power from the high-tension line and supply local lighting circuits with two-phase currents at 2100 volts in a substation at River Point, 12 miles from Providence. The frequency being 60 cycles per second, the power is well adapted for this purpose.

American Institute of Electrical Engineers.

The 141st meeting was held in New York, March 28. In the absence of President Kennelly Manager C. P. Steinmetz presided. A paper was presented by Mr. Joseph Sachs, of Hartford, on "The Evolution of Safe and Accurate Fuse Protective Devices." The discussion was participated in by Messrs. G. S. Dunn, L. W. Downes, W. C. Woodward, H. C. Wirt, W. J. Hammer, F. V. Henshaw, C. O. Mailloux, Fremont Wilson and C. P. Steinmetz. Resolutions of respect to the memory of the late S. Dana Greene adopted by the Council were read by the secretary. At the meeting of the Council in the afternoon the following associate members were elected: Arthur C. Babson, Berkeley, Cal.; Max D. Baron, New York City; Francis O. Blackwell, Schenectady, N. Y.; J. Walter Esterline, Lafayette, Ind.; Fred. Alan Fish, Columbus, O.; Carl F. Fog, Lynn, Mass.; Irwin John Macomber, Chicago, Ill.; Harry Bowman Marsh, Indianapolis, Ind.; John Motley Morehead, Chicago, Ill.; James D. Mortimer, Berkeley, Cal.; Martin Henry Offinger, Buffalo, N. Y.; Samuel W. Rushmore, Jersey City, N. J.; Aubrey Norman Shaw, Brooklyn, N. Y.; Chas. C. Stutz, New York City. Prof. F. W. Brady, of Mesilla Park, N. M., was transferred to full membership.

The New Wheel Pit of the Niagara Power Company.

By Orrin E. Dunlap.

THE new wheel pit which is now in course of construction for the Niagara Power Company at Niagara Falls, N. Y., will be 463 feet 1 inch long between channel cuts. Its approximate depth will be 180 feet, while the width between the brick walls below the turbine deck will be 16 feet and above the deck it will be 17 feet 4 inches. The walls will be slightly battered. The distance from face to face of the arris lines of masonry above the thrust deck will be 21 feet. In this wheel pit there will be installed eleven wheels, of 5000-hp each. All of the lower part of the pit will be lined with brick as soon as completed, and the upper part will be similarly lined as fast as the units are placed. Six of the units are to be installed as soon as the pit is ready for them, and the remaining five will be installed as the demand makes it necessary. The excavation for the pit is through solid rock and the sides will be channeled.

There is a water-bearing strata of rock about 60 feet below the surface, and in the new wheel pit the method of draining this water from the rear of the brick walls will be a little more extensive and complete than in the old pit, but still the walls of the old pit are kept very dry by the means adopted in their building. In the lining of the new wheel pit the inner course of brick will be hollow. Weeper holes will be constructed behind the walls and the seepage

VIEW OF NEW NIAGARA WHEEL PIT.

will be conducted to a point below the turbine deck. The brick walls of the pit will be 16 inches in thickness at the top of the turbine deck, and 12 inches at the top of the pit. The penstock mouthpieces for the complete installation will be built into the masonry when the walls are built.

Preparatory to the removal of the bank of the inlet canal for the construction of the inlets for the penstock feed, a cofferdam 550 feet long will be constructed, it being now in course of building. This dam will consist of an outer crib 10 feet wide, an inner crib 8 feet wide, and a puddle of 8 feet. The inner and the outer cribs will be filled with stone. A similar crib 120 feet long has been constructed across the end of the inlet canal close to the bridge leading from the power house to the transformer station. This crib shuts off the water from that portion of the canal east of the bridge, at the point where a shaft is being sunk. In both cribs the sheeting is driven on the inner side of cribs.

The shaft that is being sunk is to facilitate the construction of the connecting tunnel, which will practically be an extension of the present tunnel. It is located close to the power house in that section of the inlet canal east of the bridge above referred to. The dimensions of the shaft are 10x16 feet, and its depth will be about 180 feet to the bottom of the tunnel. The site of the shaft is immediately over the tunnel heading. In order to carry off the inflowing water, three 8-inch holes have been sunk through the course of the shaft into the tunnel, and through these holes the water that pours into the shaft runs to the tunnel. Two holes of the same size have been sunk in the north end of the new wheel pit at a point where they will be intersected by the tunnel when it is ex-

tended to that point. All who recall the immense amount of pumping done on the original pit during construction will realize that this method of getting rid of the inflowing water will save a very large expenditure.

The new section of the tunnel to be built will be 616½ feet in length. It will be of the same general dimensions as the present tunnel, which are 18 feet 10 inches wide and 21 feet ¼ inch high. It will be built in the form of a horseshoe, the same as the old tunnel, and similarly lined. This new section will make the total length of the tunnel 7436½ feet. It will be built on a grade of one-tenth of 1 per cent., and will have a curve 368½ feet long, the radius of curve being 186½ feet.

A small connecting tunnel or passageway will be built between the two wheel pits to allow of the passage of employees from pit to pit. This tunnel will be 6 feet wide by about 8 feet high. It will be located about 130 feet below the surface, and will connect the south end of the present pit with a point near the north end of new pit, and will be lined with brick throughout.

In sinking the wheel pit every care is taken that the blasting shall not interfere with the arrangement and working of the installation in the present power house and pit. The drills are operated by compressed air, and the benches are carried through on a uniform grade at an approximate depth of six feet.

In the compressor station the National Contracting Company has installed ten 100-hp boilers and four straight line Ingersoll compressors, known as "Class A." There are also three pumps, two feeding the boilers, giving two independent feeds throughout, and a 15-hp direct-current dynamo for lighting and a small engine for operating it.

Dr. Coleman Sellers and William A. Brackenridge, engineers connected with the Niagara Falls Power Company, have returned from Geneva, Switzerland, where they went relative to contemplated changes in the construction of the turbines to be placed in the new wheel pit, and while it is understood that certain changes will be adopted, the company is now working out the details. The changes will be based upon the experience the Niagara Falls Power Company has had with the present wheels. The new power house will be a substantial stone building, but some changes will be made in its adaptation to the requirements of the installation.

The work that the Niagara Falls Power Company now has in progress will cost several millions of dollars. That the Niagara power development should this early be extended to the full capacity of the tunnel tail-race is not only significant of the general prosperity of the country, but it demonstrates that the engineering talent in charge of the Niagara Falls Power Company's affairs of construction is the highest and best the world affords, a fact made clear by the gratifying success attained.

An Explanation of Inertia.

BY REGINALD A. FESSENDEN.

Since electricity deals with the motions of the ether, and all action of every kind is transmitted through the ether, we need feel no surprise as, one after another, this and that force are shown to be manifestations of the electric force. Chemical action has long been known to be electric in its nature, and it was in these columns (*Electrical World*, July 28, 1891) that the force of cohesion was first shown to be capable of explanation along purely electrical lines. The calculations then given have since been repeated by Chattock, Lodge and others, and the result there given confirmed.

That a body having an electric charge on it has its effective mass increased has long been known. It was first pointed out, I believe, by J. J. Thomson. (Dynamics applied to Physics and Chemistry), who gives the amount of added inertia as $\frac{4}{15}\frac{e^2\mu}{a}$ where e is the charge on the sphere, a is the radius of the sphere, and μ is the permeability of the medium. If we calculate (taking the value of the ionic charge as 4×10^{-10} electrostatic units, and the radius of the silver atom as 1.25×10^{-8} cm.), how much inertia the ionic charge would add to the mass of the atom, we find it infinitesimal as compared with the actual mass. Consequently the theory suggested by several scientists that the mass of an atom might be an electrical effect has seemed to be distinctly negatived.

It has long been considered as probable—as far back, indeed, as the time of Lucretius—that the atoms were built up of smaller parts. In a paper on "Insulation and Conduction" (*Electrical World*, February 25, 1893) it was somewhat more definitely suggested that the atoms might consist of dynamically stable groups of vortex-rings, and the carbon atom is shown so figured. This hypothesis, i. e., that the atom is complex, which at that time had little formation, has recently been shown by the epoch-making discoveries of J. J. Thomson to be probably correct. He has shown that the atom consists of many smaller parts, and that even in the hydrogen atom the number of these electrons is at least of the order of one thousand.

Many consequences follow from this wonderful discovery, but perhaps one of the most important is the fact that we have now no longer any need for inertia as a separate force. For if we take the hydrogen atom as containing 3000 electrons, each electron 1-300th of the diameter of the original atom, we find that the fraction $\frac{4}{15}\frac{e^2\mu}{a}$ (or $\frac{e^2\mu}{3a}$ according to Heaviside), is now equal in amount to the mass of the hydrogen atom. In other words, the electric charges on the electrons give the full inertia effect, and there is now no longer any room for a separate force due to inertia.

Electrical Ignition for Gas and Gasoline Engines.

BY P. P. NUNGESSER.

IN the early days of gas and gasoline engine construction the only method of ignition was by what was commonly known as the hot tube. The tube which entered the combustion chamber or cylinder, was heated to redness by a gas or gasoline burner, which necessitated the maintaining of an open flame outside of the engine cylinder. The many dangers accompanying this form of ignition, especially on gasoline engines, made it in some localities extremely hazardous, while there is an uncertainty in the period in which the ignition would actually take place due to high or low compression. Under favorable conditions, such as tight fitting cylinder rings on the piston head, and perfect fitting valves, whereby high compression was obtained and the explosive mixture forced into the hot tube at a pressure corresponding to the igniting temperature, the ignition would take place at a proper period of the stroke, and high efficiency was the result. But a slight leakage at the rings on the piston head lowered the compression which, together with the frequent breakage of the heat tubes, due to the oxidation and other uncertainties of this method of ignition, soon led the inventors and manufacturers of gas and gasoline engines to seek a more reliable means of ignition, free from the many dangers accompanying the use of the hot tube.

This method was found in the application of the electric igniter to such engines. However, many builders of gas and gasoline engines have frequently met with difficulties, and sometimes failures, in their efforts to obtain satisfactory results in the electrical ignition under the various conditions existing. This is due to the many details which are overlooked and regarded by many builders as unimportant.

The great strides that have been made in the perfection of the gas and gasoline engine, especially adapted for automobile service as well as all forms of stationary motive power, has made this a very important industry, the growth and magnitude of which can hardly be conceived by those not directly or indirectly interested in this progressive industrty. The high state of perfection met with to-day in this important source of mechanical energy as applied in its comparatively new field of usefulness on automobiles and pleasure yachts, is due in a measure to the great improvement made in the electric igniters, spark coils and batteries. Perfect ignition is the most important factor in producing successful results. Engines which have igniters that combine durability with simplicity of construction have met with the greatest success in the hands of the average operator.

The writer will endeavor to explain the most successful igniting devices in use at the present time. They consist of two distinct classes—the primary and the secondary—the latter commonly called the "jump spark" igniter. The primary igniters which are by far the most largely used by the engine builders in this country, are constructed in three distinct forms. The first, known as the striking or "make and break" contact, employs points which are made to pass through the side of the cylinder or through the cylinder head into the combustion chamber. The movable point which strikes against the stationary point is actuated by a suitable mech-

anism on the outside of the cylinder. This mechanism is usually so arranged that ignition can be produced at the highest point of compression, or at the point where the highest efficiency is obtained with the combustible mixture employed.

The second form of primary ignition, commonly known as the rotary or wipe spark igniter, is not so largely used as the striking or make and break type just described. One objectionable feature which the writer has not yet seen successfully overcome in the rotary type, is the great wear in the sliding contact points. It is true this form of ignition produces a much larger spark with the same consumption of battery power than the striking or make and break igniter, but the frequent attention that this form of sliding contact ignition requires to keep it in perfect condition, will prevent it from ever coming into so popular favor as the striking or make and break ignition.

The third form of primary ignition used is the make and break igniter known as the inside igniter. This igniter is constructed by passing an insulated stationary rod through the side wall of the cylinder, or through the cylinder head. The movable part of this igniter is attached to the piston head inside of the cylinder, and when the piston head compresses the explosive mixture to the highest point of compression, the igniter, which has been brought in contact by the forward motion of the piston, is separated by the movement of the piston head, thereby igniting the mixture. There are many other forms of primary ignition in use, but those described above are the most largely used in this country.

The second class of igniters, commonly known as the jump spark igniters, have only one form of construction. This is an insulated plug through which the wires from the induction or secondary coil pass to the inside of the combustion chamber. The two wires which pass through the insulated plug are usually spaced from ½ to ⅝ inch in passing through the plug, and curved inward or toward each other to allow from ⅛ to 5-16 inch air space through which the spark passes from the positive to the negative wire. It will be noticed that no movable parts exist in this form of ignition. When the battery is closed by suitable insulating plates on the revolving shaft of the engine, a spark is produced in the combustion chamber or cylinder.

The insulating plugs used for this secondary current or jump spark ignition, must necessarily have very high insulating properties. They are usually made of so-called lava or soapstone, or of mica having high insulating properties.

The Rhumkorff, or induction coil, as it is sometimes called, which is used to produce the jump spark, is constructed with a primary coil of coarse or heavy wire having a soft iron core. Over the primary coil is wound a great many layers of very fine, insulated copper wire having no metallic connection with the wires of the primary battery coil.

When a battery current passes through a primary coil it magnetizes the iron wire core, and also charges a tin foil condenser, usually placed in the base of the coil. When the battery circuit is closed, a current of very high voltage is produced by induction in the secondary coil, the ends of which terminate in the ignition plug inside of the combustion chamber. This high voltage causes a spark to pass from the positive to the negative wire inside of the combustion chamber.

To ignite an engine successfully with any of the above forms of ignition, a battery of great strength and durability is absolutely essential. These requirements have to be met by a closed circuit battery manufactured expressly for the purpose. Practical tests and demonstrations on automobile and yacht engines have shown that a battery having from 4½ to 6 volts, or ¾ to 1 volt per cell is required. The battery should have a very low internal resistance, and have an amperage or discharge rate of from 8 to 16 amperes on closed circuit measurement.

Too much cannot be said about the use of a suitable primary spark coil in connection with any of the primary igniters. It has required many tests to determine the correct resistance for a coil. If the resistance is too low, the coil will allow too large a flow of current from the battery, thus wasting very much of the battery power, and also frequently destroying the platinum points on the igniter. To obtain the best results, from 1½ to 2 amperes should be the limit of discharge through the coil. Coils are now wound for 4, 6 and 8 cells, as the case may be.

Since the early days of electrical ignition, many forms of spark coils have been used; in fact, any coil that would produce a large spark was considered the correct coil to use irrespective of the great waste in battery power. Many spark coils in use to-day are wasting as much current as is required to successfully ignite the engine. This is due to the very low impedance of such spark coils, which allows a greater quantity of current to flow through the coil when the circuit is closed, than is necessary for successful ignition. This waste of current is prevented by having the correct impedance in the coil so as to produce a reliable spark and prevent any waste in the battery power. It has been found from actual tests on modern engines that by having a coil of the correct impedance, the life of the battery may be doubled.

Another great improvement in ignition and saving in battery power was effected by discarding the old style long coils, which were 8, 10 and 12 inches in length, an erroneous idea having existed that a long coil would produce a larger spark. Practical experience and tests have shown that a primary spark coil best suited for high speed engines, such as used on automobiles and pleasure yachts, should not exceed 6 inches in length over all. The 8, 10 and 12-inch coils will not, with the same consumption of battery power, magnetize and demagnetize as rapidly and completely as the 6-inch coil; consequently the latest improved primary coil has an extra large diameter core, which is composed of No. 20 annealed Swedish iron wire, reannealed after cutting to 6 inches in length. A coil having a core made of this grade of iron and with this degree of care, will magnetize and demagnetize instantaneously. This enables the engine builders to provide for only a short duration of close; that is, allowing the circuit to remain closed less time than would be required to produce the same results with an 8, 10 or 12-inch coil. It is, therefore, a great economy in battery power to use a 6-inch coil, and the results are much more satisfactory.

Another important feature in the construction of primary spark coils for automobile use, is the thorough waterproofing of the spark coil to produce thorough insulation under all conditions met with in portable use. No spark coil, if not proof against dampness and moisture, will give satisfactory service for any period of time; it is, therefore, necessary to have the spark coil thoroughly waterproof.

In the opinion of the writer, no form of dry battery should be employed for continuous use. The first cost of a dry battery and sal-ammoniac battery is very low, but its life in heavy service is very short. Dry batteries are sometimes used for starting an engine where a dynamo is used for continuous ignition. A number of builders are using dry batteries for starting their engines, and as soon as the required maximum speed is obtained, an automatic switch cuts the battery out of the circuit and closes the dynamo circuit. This is also sometimes accomplished with a two-point switch, and the dynamo will then ignite the engine until the speed is reduced. While the dynamo or generator is used, the batteries are at rest.

The writer considers a good portable closed circuit battery not only more economical than the dry battery and dynamo combination, but it requires less care, as there are fewer parts to become disarranged in the rough service to which ignition devices are subjected to in gasoline propelled automobiles and pleasure yachts. It is a mistaken idea that dynamos or magneto-generators do not require any attention or repairs. The high speed at which these generators are usually driven produces considerable wear on the movable parts, so much so as to have caused them to be abandoned by many of the progressive builders.

Many builders of automobile and yacht engines have had difficulties, no doubt, with the many forms of closed circuit batteries. These difficulties are sometimes easily located. A closed circuit battery in which a paraffine oil must be used on the solution, is objectionable, as it will be found to give short life and comparatively poor service, for the reason that the rough usage in carriages and boats cause the paraffine oil to coat the elements and interfere with the action of the battery. A perfectly sealed or liquid-tight battery does not require any oil to protect the solution from the atmosphere. A battery which may show excellent service in stationary use may be a complete failure in portable use.

There are no trade secrets about electrical ignition. The degree of success that the various manufacturers are meeting with depends entirely upon the amount of attention that has been given to the most important details, which the writer has endeavored to explain in this article. There are perhaps other causes for success or failure in electrical ignition, but those referred to in this article are from the writer's personal experience, and observations made in the past ten years, or since the development and perfection of the gas engine.

Hunting of Alternating Current Apparatus.

By H. W. Buck.

IN electrical engineering the phenomenon of hunting is usually spoken of in connection with the well known difficulty experienced in many rotary converters, but it is in reality a fundamental characteristic of all alternating current machines which operate in synchronism with the frequency of the source from which they are driven. To this class of apparatus belong rotary converters, synchronous motors, alternating-current generators and motor-driven rectifiers.

Hunting is essentially a mechanical oscillation, not an electrical one, and such pulsations of current and voltage as exist when the phenomenon is taking place are a result of the mechanical swing set up and not the cause of it. In general, the laws which govern hunting are very similar to those in certain systems in mechanics and can best be explained by reference to a few simple examples of the latter. In Fig. 1 is shown a simple pendulum; as is well known, if this is displaced from its position of rest and released, it will swing back and forth with a certain definite period which, for a given length of pendulum will depend upon the force of gravity. If the force is increased the period will be faster; if the force is diminished the period will be slower—the natural period therefore depending upon the length of the pendulum and the force acting to bring the mass *M* to its neutral position.

Fig. 2 shows another mechanical system in which *D* is a disc pivoted at *P* and held in a certain position of rest by the two spiral springs *S*, *S*. If this system be displaced it, too, will oscillate with a definite period depending upon the moment of inertia of the disc and the strength of the spiral springs. If the mass of the disc is increased the period will be slower; if the springs are made stiffer the period will be more rapid. If to such a vibratory system small periodic impulses be given, they will have very little effect unless they

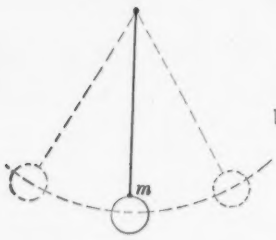


FIG. 1.

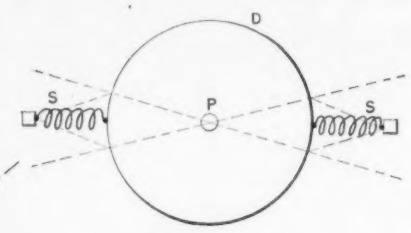


FIG. 2.

approach or exactly equal in their time period the natural period of swing of the oscillating parts. If they do so coincide, even if they are very small in magnitude, they will in time build up an oscillation of the system which will have a very large amplitude as compared with the strength of the individual impulses given. Numerous examples of this phenomenon of mechanical resonance exist, such as the large vibrations of a bridge sometimes set up by a body of men walking in step across it.

The electrical system shown in Fig. 3 is analogous to the mechanical one given in Fig. 2. If direct current is passed through the coils and *D* is displaced it will also oscillate back and forth, the period depending upon the moment of inertia of *D* and the strength of the magnetic field. The flux in this case corresponding to the spiral springs in Fig. 2 and giving the elasticity to the system. If while the oscillation is taking place the yoke *Y* is rotated, it will drag *D* around with it by the magnetic attraction, but the oscillation between *Y* and *D* will continue with the same period as if both were at rest, and will be governed by the same laws; the swing being superimposed upon the rotation.

This now is the condition which exists in all polyphase synchronous apparatus. Instead of the mechanical rotation of the yoke *Y* referred to, the poles are electrically rotated by means of polyphase currents and the field poles established by the direct-current excitation are dragged around with them by an electric connection which permits mechanical oscillations between field and armature to take place—the period as before being fixed by the moment of inertia of the rotating parts and the strength of the magnetic field. If therefore periodic variations of voltage or of frequency be impressed upon a synchronous machine while it is running, and if the period of these impulses approximates the natural period of the machine, a swing of large amplitude between field and armature results and the so-called phenomenon of hunting will exist.

The principal sources of the impulses which cause machines to hunt are rapid fluctuations of load on the system, periodic movements of the governors of the prime movers and the inequality of frequency in direct-driven steam alternators caused by variations in turning moment on the engine shaft at different portions of the engine stroke; the latter being by far the most important. This can be reduced to a very small quantity by using large flywheels on the engines, but even a very small variation of about .1 per cent. in frequency may be enough to cause violent hunting of some of the machines connected to the system.

When a machine is hunting in this way pulsations of current will flow in its armature which may be greater than the full load current, and causing, if it is a large machine, a very serious disturbance in the voltage of the system.

Starting therefore with a periodic impulse which may not be greater in magnitude than .1 per cent., a pulsation on the system may result which will fluctuate the voltage 5 per cent. or 10 per cent., the original impulse being magnified in effect by the mechanical resonance or hunting of some of the machines connected to the system.

The results of hunting are probably more troublesome in the case of rotary converters than in other classes of apparatus. Rotary converters are essentially synchronous motors running without load, since there is no mechanical torque on the shaft, the armature being free to oscillate through a large amplitude. While these oscillations are taking place the field flux tends to follow the armature pole, first one side and then the other of the pole piece, as shown in Fig. 4. The neutral point of the machine regarded as a direct-current generator therefore surges back and forth in period with the hunting, causing serious sparking at the brushes. This frequently results in flashing over on the commutator. The pulsations of alternating cur-

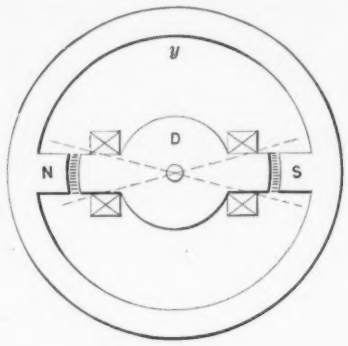


FIG. 3.

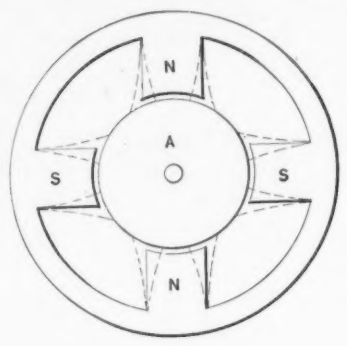


FIG. 4.

rent which are caused by the hunting make the direct-current voltage at the commutator vary in proportion.

A number of devices are used for the purpose of preventing hunting in rotary converters, the most common of which are polar windings or bridges of copper shown in Fig. 5. When the magnetic flux tends to surge back and forth across the pole face, the lines of force cut the copper bars on the edge of the poles and the resulting current in this polar winding opposes this movement of field flux; and the power consumed by the eddy currents in the copper damps down the vibration.

Rotaries seldom pump when driven from water-wheel alternators where the frequency is constant, or from belted alternators; but in systems operated from direct-coupled engine-driven alternators the inequality of angular rotation of the engine shaft is sufficient to start violent pumping in many cases. Since large mass tends to produce slow natural periods and large amplitudes of oscillation, rotary converters of slow speed and large armature diameter generally hunt more than small high speed ones. High frequency converters therefore give more trouble from hunting than low frequency machines, since the armature is necessarily of large diameter with a large number of poles. The neutral point being narrow, a small surging of flux causes sparking at the commutator.

Synchronous motors, since they are always run with some mechanical load on their shaft, seldom hunt to any extent, although frequently hunting at no load. In certain synchronous motor-generator sets, however, where the mass of the moving parts is large, the amplitude of swing, even at full load, is sufficient to cause a pulsation in the voltage of the machine which is driven as generator; the oscillation being communicated to the generator armature through the shaft.

Rectifiers which are recently coming into use are usually driven by a small synchronous motor. For the satisfactory operation of a

rectifier the brushes should pass from one segment of the rectifier to the next at a certain definite instant. If the motor hunts the rectifying commutator will oscillate with it and the brushes will pass from one segment to another too soon on one half of the oscillation and too late on the other, and violent sparking will be the result.

An alternating current generator running in parallel with another one can be regarded as a synchronous motor, and is held together with the other one simply by the synchronizing current, which furnishes an elastic bond between the two. They can therefore oscillate, if impulses are furnished to keep the vibrations alive. If there is any load on the generators these oscillations soon die out unless, in the case of direct-coupled steam-driven alternators, the engine governor is sensitive enough to respond to the swing. In this case steam impulses are given to the generators which cause the swing to be built up to a very large amplitude. The cure for this trouble has been pointed out in an article by W. L. R. Emmet in the Electrical World and Engineer for Jan. 20, 1900, consisting in retarding the engine governors by special means to such an extent that they cannot respond to the oscillations.

An alternating current system, therefore, comprising alternating current generators, synchronous motors and rotary converters, is one which is highly oscillatory, each element capable under favorable conditions of responding to impulses which may exist on the circuit, and magnifying them to such an extent that the circuit will be seriously disturbed. If one machine starts to hunt it may react on the system and cause others to oscillate. So many factors determine whether a machine will hunt, that it is impossible to predetermine whether a

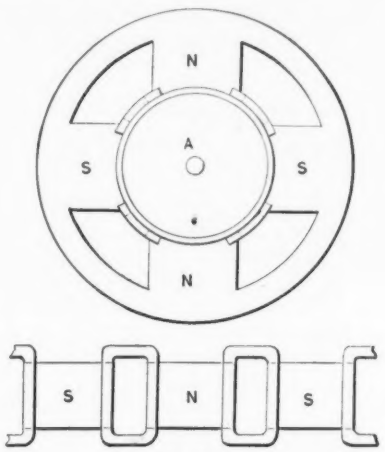


FIG. 5.

certain machine will hunt on a given system or not. The period of the impulses given to the circuit, the inertia of the armature, the strength and distribution of the magnetic field, and the eddy currents induced to oppose the oscillations, all enter into the result and cannot be calculated. Machines which will hunt on one system will operate with perfect stability on another. A machine which is the best designed in point of efficiency and heating may hunt the most violently when put into operation.

As long as steam engines are used as prime movers for alternators, impulses in time with the engine strokes will be given to the circuits which they operate. These impulses, which are the chief source of the trouble, can only be reduced to a minimum by using carefully designed engines, preferably of high speed, with large flywheels. But even under the most favorable conditions certain machines may show a tendency to hunt when first put into operation on a system.

In nearly all cases, however, where trouble is experienced some slight changes in the design or adjustments of the machine can be made which will change its constants to such an extent that it will no longer respond seriously to the fluctuations in the circuit.

Consolidation of Lighting Interests in New Jersey.

On March 29 articles were filed in Trenton, N. J., merging twelve electric light and power companies of Hudson and Essex Counties into the People's Light & Power Company. The new company has an authorized capital of $20,000,000, and the companies absorbed by it are the following: Newark Electric Light & Power Company, the Thomson-Houston Electric Company of Newark, the Essex County Electric Company, the Suburban Electric Light & Power Company, the Montclair Light and Power Company, the Central Power Company, the Consumers' Electric Light & Power Company, the Excelsior Electric Company of Harrison, the Kearny Electric Light Company, the Hudson County Electric Company, the Jersey City Electric Light Company and the Newark-Schuyler Electric Light Company. Upon the surrender of the stock of the merged companies capital stock of the new company will be issued to the extent of $5,500,000. The officers and directors of the new company are Philip N. Jackson, of Newark, president; Dudley Farrand, of Newark, vice-president; L. D. H. Gilmour, of Newark, secretary; Percy Ingalls, of Newark, treasurer; Randall Morgan, of Philadelphia; Matthias Plum, Jr., of Newark, and William Fairlee, of Newark, directors.

The Coal Famine in Continental Europe.

The fact that American coal is being sent to Europe is attracting much general attention at the present time. It is evident that there is such a scarcity of coal on the continent that manufacturing interests are becoming somewhat demoralized, according to recent communication to the State Department from consuls in France and Germany. Mr. Frank H. Mason, consul general at Berlin, Germany, in his account of the effects of the coal famine in that country, says that the prosperity of the iron and steel industries there has become seriously jeopardized by the scarcity of coal, especially the qualities adapted to coking for blast-furnace fuel. This, he says, will inevitably restrict the pig-iron output of the current year, which during the final eleven months of 1899 increased to 7,406,171 metric tons, as compared with 6,740,379 tons for the corresponding period of 1898. In consequence of the shortening supply of pig iron, all other cognate materials have advanced in price, so that old iron now commands 81 marks ($19.27) per ton; lathe shavings, 76 marks ($18.08) per ton; and old rails, 107 to 112 marks ($25.46 to $26.65) per ton. All mills which manufacture hoop iron, girders, boiler and ship plates, and all kinds of structural iron are filled with orders and begging for more time for deliveries. The situation has been aggravated by the extreme scarcity and high prices of coal—especially anthracite and gas coals—in Great Britain, which has for the moment practically cut off what has been hitherto an important source of supply for Germany. These circumstances combine to form a new and important opportunity for the coal exporters of the United States. Letters are received at this consulate from importers of English anthracite and gas coals, complaining of the meager supply and high prices, and asking to be put into communication with American exporters of those grades. If, in addition to the enormous quantity of coal now being consumed in the United States, Mr. Mason suggests, there remains any considerable surplus for export, and the conditions of freight are not prohibitory, the present season offers a rare and fertile opportunity to establish in the German market the standard grades of American anthracite and gas coals. In a subsequent report Mr. Mason states that numerous important glass, porcelain and machine factories in Silesia and Saxony have been obliged to shut down for want of fuel, and that there are a dozen electric lighting and power plants in the country which have less than a fortnight's coal provision on hand and no source from which to obtain further supplies. The administration of Prussian State railways is said to have closed its contract for an immense coal supply at an advance of 42 per cent. over the high price hitherto paid. From the best obtainable information, Mr. Mason says, it is estimated that Great Britain, which exported to Germany about 5,000,000 tons of anthracite and bituminous coals during the year 1899, will not be able to spare for this country more than 2,000,000 tons during the present year; so that there will be a deficit of about 3,000,000 tons in the imports from that country alone, which will have to be filled from some other source. In Russia, the situation is equally urgent and critical. The enormous and rapid development of railways and certain manufactures in that country during the past three years has completely outrun the limited domestic coal supply, so that naphtha fuel, which has been hitherto largely used, has advanced in price from 4 to 19 kopecks (2.06 to 9.8 cents), and the Russian Government has sought to ease the pressure by suspending for an indefinite period the usual prohibitory import duty of $2.80 per ton on coal. Even the Russian Government railways are said to be short of coal, and an agent has been in Berlin vainly seeking to place an order for several hundred thousand tons for that purpose.

CURRENT NEWS AND NOTES.

MR. C. J. FIELD, chairman of the Technical Committee of the Automobile Club of America, will give "A Practical Talk on Automobiles" on Saturday evening, April 7. Members of the Automobile Club and other automobilists are invited.

AN ENGLISH ELECTRIC LIGHTHOUSE.—The light on Little Cumbrae, an island at the mouth of the Firth of Clyde, has been fitted for electricity. Four dynamos are driven by oil engines, any one of which can also be used to work the pumps for supplying air to the siren fog signal. The supply of oil is transferred from boats by an electric pump. An electric motor is employed to revolve the lens chariot.

A DIRECTORS' MEETING BY TELEPHONE.—The directors of the Connellsville, Klondike & Normalsville Telephone Company, of Connellsville, Pa., held a unique meeting last week. The directors live many miles apart, separated by mountain ridges; each one, however, has a telephone. All got together on the line, increased the capital stock of the company from $3000 to $5000 and also transacted other business. Motions were made, seconded, and resolutions offered and adopted over the wire.

GENERAL MANAGER FOR THE RAPID TRANSIT COMPANY.—Mr. August Belmont, president of the Rapid Transit Subway Construction Company, has announced that Mr. E. P. Bryan, of St. Louis, Mo., has been appointed general manager of the company. Mr. Bryan has resigned the position of general manager of the St. Louis Terminal Association to accept the Rapid Transit offer. He will receive a salary of $20,000 a year in his new position, the appointment to which is for five years.

A. I. E. E. NOMINATIONS.—The following nominees were selected by the Council of the American Institute of Electrical Engineers for the annual election May 15: for president, Carl Hering; vice-presidents, Gano S. Dunn, Arthur V. Abbott and W. L. R. Emmet; managers, W. S. Barstow, Calvin W. Rice, C. T. Hutchinson and R. D. Mershon; treasurer, G. A. Hamilton; secretary, R. W. Pope. Dr. M. I. Pupin was appointed a manager to serve during the unexpired term of the late S. Dana Greene.

YUKON TELEGRAPH RATES.—The Great Northwestern Telegraph Company has definitely completed its arrangements with the Dominion government for transmission of cable and press despatches to and from places on the Yukon line. The rate from Victoria, B. C., on cablegrams is 33 cents per word to and from places on the Yukon line. The rate from Victoria, B. C., on cablegrams is 33 cents per word and on press despatches four cents per word, there being in the case of press despatches a minimum charge of $2.50.

RELIGION BY TELEPHONE.—The First Baptist Tabernacle of Cincinnati, O., is to be connected by telephone with church members who may wish to listen to their pastor's words while taking their ease at their own firesides. The church has been wired by the Citizens' Telephone Company, and a large transmitter will be hung in front of the pulpit, to which private lines will be connected. This is not the first experiment of the pastor, Dr. Barbour, in preaching by telephone. Several years ago he had a transmitter installed by his pulpit, to which was connected the telephone of an elderly lady, who was an invalid and unable to attend church, and every Sunday for nearly four months she listened to the service through the telephone.

THE FRANCHISE TAX.—Under the Ford franchise tax law in New York State it is proposed that corporations shall pay four-fifths of the $10,000,000 which are to be raised under the law. The amount of the tax is generally reached by assessing the capital stock 2½ per cent., although the rule is not arbitrary. Among the corporations of large capitalization are the following, with the amount of capital and the amount of tax in each case: Metropolitan Street Railway Company, $45,000,000, $1,875,000; Manhattan Elevated Railway Company, $48,000,000, $1,500,000; Third Avenue Railway Company, $16,000,000, $300,000; Brooklyn Rapid Transit, $45,000,000, $1,200,000; Consolidated Gas Company, $54,952,200 $2,424,657.

A NEW MOTOR WINDING.—A patent issued to H. F. Joel, of London, England, describes a winding for a motor armature which, it is claimed, renders a maximum portion of the winding effective in induction while a minimum is absorbed in ineffective connections. The field is of the Brown internal field type in which the poles are arranged to interspace with each other, and thus lie in the same plane of rotation. The armature is slotted and has one slot more than an even multiple of the number of poles. The winding is of the wave form, and instead of the two connecting ends being carried down to the commutator, they are united in the cylindrical plane of the armature face and the union connected to the commutator segment.

AN ITALIAN ELECTRIC FURNACE.—The Stassano electric furnace, which has been tested in an experimental plant of 100-hp near Rome, is claimed to reduce the cost of producing iron and steel about one-third. The apparatus resembles in appearance a blast furnace of very small size, the heat being supplied by an electric arc between carbons entering opposite openings at the bottom of the furnace and adjusted by hand. Carbonates and oxides are the ores usually treated. The former are first roasted, and it is necessary to powder all the ores and mix them with such proportion of carbon, lime or silica as analysis may show to be necessary for producing the desired quality of metal, and then to form the powdered mixtures into bricks with 5 or 10 per cent. of pitch under hydraulic pressure. The dried bricks are fed into the heated furnace, the treatment then lasting a little more than half an hour in a test producing a small ingot. The process is aided by the combustion of the carbon of the mixture, and the electric energy required for each ton of metal is estimated at 3000 hp-hours. Further experiments are to be made with three furnaces of about 500-hp each, capable of yielding about 4000 tons of metal annually.

CANADIAN GOVERNMENT TELEGRAPH SYSTEM.—A bill has just been introduced into the Dominion Parliament providing for the establishment in Canada of a government system of telegraphs as a branch of the public service of the Dominion. It authorizes the government, when Parliament provides the money, to establish a system of government telegraphs throughout Canada, either by construction of new lines or expropriation of existing lines. The bill provides that the rates shall be uniform throughout the country, a maximum of ten cents for ten words on private messages, and ten cents per 100 words on press telegrams. Mr. Casey, who introduced the bill, spoke of the splendid results of the government system of telegraphs in Great Britain. The discussion brought out some interesting facts in connection with the system already under government control. It appears that the marine department contemplate connecting the lighthouse station at Belle Isle with the mainland on the Labrador coast by means of the Marconi system of wireless telegraphy. Experiments made to establish communication with Sable Island by means of carrier pigeons have failed, and the suggestion is made that the Marconi system should be tested.

ARMATURE BALANCING COILS.—It is sometimes found in practice that both alternating and direct current generators having two-circuit or series windings, and alternators having open coil windings, are unbalanced magnetically, due to one or more of a number of causes—such, for example, as unequal wear of bearings, defective castings, unequal field magnetic coils and unequal rate of increase or decrease of the strength of the pole due to changes in load, etc. In order to equalize the magnetic circuits, B. G. Lamme, in a patent granted March 27, proposes to provide the armature with a winding or windings closed upon itself and independent of the main generating winding of the machine. If these closed windings are symmetrically located with reference to the poles of the machine, leading and lagging currents will be generated therein, and the flow of current in either one portion or another will produce the balancing effect desired. In illustrating the application of the method, an 8-pole machine is shown having an armature of the ordinary slotted drum type. In addition to the usual generating winding, eight supplemental balancing conductors are located in eight equidistant slots; four of these, separated by 90 degrees, are short circuited by a ring at each end of the drum, and the other four are similarly short circuited on themselves. While four conductors alone can be used with an 8-pole machine, the two circuits, as above described, give a more fairly uniform balancing effect. If desired a still larger number of conductors in sets of four might be used.

ENGINEERING SOCIETY'S LIBRARY, UNIVERSITY OF MICHIGAN

THE NEW HAMBURG STEAMER DEUTSCHLAND will contain 2000 incandescent lamps and a full searchlight equipment. The electric generating plant will consist of five direct-connected units. The propelling machinery of this vessel will develop 33,000-hp, or 16,500-hp per shaft—the largest amount of power ever transmitted through a single shaft.

COMMUTATORLESS DYNAMO.—A patent issued March 27 to Gustaf Dalen and Arthur Hulquist, of Stockholm, Sweden, describes a commutatorless (unipolar) dynamo with a double armature, the e. m. fs. of which are added. The armature consists of two disks each in its own field, which fields are juxtaposed so that the edge of the disks may be in contact. The flux of magnetism is such in the two fields that the e. m. fs. are added, and the current is taken off by a brush on each shaft.

INDUSTRIAL EXPOSITION IN INDIANAPOLIS.—A permanent exhibition of Indiana inventions, manufactures and products has been established in the Cyclorama building in Indianapolis. The building will be subdivided for the display of devices of Indiana inventors, and the products of the factory, mills and shops. No other exhibits will be admitted. There will be a large exchange room, with offices for such manufacturers as may require them; a telegraph office, an amphitheatre for public meetings, and local and long distance telephone booths. Heavy machinery will be represented by model only. The purpose is to conduct the exhibit purely in the interest of inventors and the public.

MR. W. J. JOHNSTON is the subject of a two-column article in the *China Mail,* of Hong Kong, of Feb. 3. The interviewer gathered Mr. Johnston's impressions concerning the Philippine situation, and the report includes a description of the battle of Santa Rosa. Asked concerning his sensation when under fire, Mr. Johnston stated that it was much more pronounced before the action began than afterward. "As soon as the trouble is on, one has too many other things to think about to have time to speculate regarding one's own personal safety. When you find you have not been hit, moreover, you feel reasonably sure you are not going to be, and unconsciously forget that there is any particular danger."

EXHIBIT OF AUTOMOBILES AT THE PAN-AMERICAN EXPOSITION.—The exhibit of automobiles at the Pan-American Exposition promises to be very extensive. Mr. Thomas M. Moore, chief of transportation and exhibits, states that replies received from different quarters indicate that this feature of the exposition will be a success in every particular. Nearly 75 per cent. of the responses received to the circular sent out, requesting suggestions as to the plan for display by evolutions, races, etc., expressed a desire to cooperate with the exposition management, and a determination to make the best possible exhibit. A cordial spirit is evinced by all prospective exhibitors, which is gratifying to the exposition management.

TELEPHONE IN WARFARE.—The mails from South Africa to England brings a series of letters from Colonel Baden-Powell to his relatives, extracts of which are published in an illustrated weekly. The defender of Mafeking writes: "Here I sit in my bombproof bureau writing these letters. Around me is telephonic communication with each one of my outposts. At each of these outposts a telescope keeps constant watch on the Boer outposts and guns. As soon as it is seen which way their fire is about to be directed the wire communications are set to work, and a bell, with which each defensive quarter is provided, clangs in that part of the town where the shell is about to fall, and all in the open at once go to ground like rabbits."

TEST OF BUFFALO RAILWAY POWER HOUSE.—Profs. H. J. Ryan and R. C. Carpenter, of Cornell University, recently made an elaborate test of the power house of the Buffalo Railway Company. Four 24-hour runs were made, the first two under ordinary conditions of operation. One of these turned out to be so abnormal on account of a great snowstorm that a second run was made in order to get at the facts of more normal operating conditions. This plant, it will be recalled, receives 2000-hp from Niagara Falls, develops about 7000 steam-hp and uses a 300 ampere-hour storage battery, which is often discharged in one hour. In conducting the test the services of 83 young men from the senior and junior classes of Cornell were utilized.

THE INTER-BOROUGH RAILWAY TUNNEL.—The New York, Brooklyn & New Jersey Rapid Transit Company has submitted a communication to the Rapid Transit Commission, accompanied by a map of a proposed route for an inter-borough railway tunnel. The route is from Cortlandt Street ferry under Maiden Lane, under the East River to City Hall Park, Brooklyn Borough, thence by a curve, back to the bridge plaza and then back to the starting point. The tunnel will be 80 feet below the surface of the water. The company expects to make connections with the rapid transit railway. It is estimated that the cost of the tunnel will be from $4,000,000 to $5,000,000 per mile, making the total cost nearly $30,000,000. This company is preparing to carry out its project, the Long Island Railroad Company having withdrawn its application for a similar franchise.

ELECTROLYTIC APPARATUS.—In a patent issued March 27 to M. Hazard-Flamand, of Boulogne-Sur-Seine, France, an apparatus is described for obtaining gases by electrolysis free from admixture, the gases being so separated from the moment of their production onward, that no gas disengaged from one electrode can become mixed with the other even if a difference of level or pressure occur in the apparatus. The negative electrode is formed by a vessel of cast-iron, the interior of which is divided into electrical compartments by means of ribbed partitions. The positive electrode is formed of plates of cast-iron placed within the compartments of the outer vessel. The positive plates are so arranged that a liquid joint is formed between the positive and negative surfaces, so that while the current can pass freely through the liquid, the escape of gases through the rings is absolutely prevented. The gases disengaged at the electrodes are thus kept from mixing.

RECENT WORK OF HUTIN AND LEBLANC.—There were issued on Feb. 27 to Messrs. M. Hutin and M. Leblanc by the United States Patent Office, three patents covering radical improvements in polyphase apparatus. These improvements, with many others, were described by M. Leblanc in the study on the transmission and distribution of energy by means of alternating currents presented during the past year before the International Society of Electricians. Of these three patents, one covers the improved polyphase converter or rectifier which has been applied commercially in many installations in France. The patent describes one such machine taking three-phase current at 6000 volts and delivering a direct current of 1600 amperes at 250 volts. Briefly the apparatus consists of a polyphase transformer with connections such that a great many secondary phases are obtained from the original few primary. In the case of this particular machine the number of secondary phases is 48. Currents from these 48 phases are taken to the collector rings of a rectifier, the collector rings being connected to commutator segments from which current is drawn in the usual way. The machine is hardly a rectifier, since the connections of the three phases with which it is supplied are not reversed by six commutations per cycle. Neither is it exactly a rotary, since the coils to which the alternating currents are led and from which the direct currents are taken, are stationary on the cores of a polyphase transformer and not movable on the armature of an electrodynamic machine. The machine, or "redresseur," as it is called in French, is a sort of intermediate type of apparatus, possessing some of the features of both the rectifier and the converter. It forms virtually the equivalent of a commutator for the alternator by which it is supplied, performing at a distant point the service which a commutator on the machine itself would perform. The other two patents cover the use of the so-called alternating "recuperator," which is a device for reducing the apparent self-induction of alternating-current circuits, particularly that of induction motors. The recuperator is an electrodynamic machine which can readily be made to give a capacity effect or negative reactance in circuits of very low frequency, such as those of the secondary of an induction motor running with a slight slip. It consist of a coil or other movable conductor disposed in a magnetic field, and oscillating in time with the low-frequency alternating current supplied to it. Untechnically expressed, the magnetizing or leading current which this device gives to the circuits to which it is connected is due to its inertia and the consequent lag of its oscillations behind the impulses given to it by the current sent into it.

THE EXHIBIT OF THOMAS A. EDISON at the Paris Exposition, now about ready for shipment, will require no less than 375 cases. Three of Mr. Edison's assistants will sail next week for France with the exhibit, which is expected to be in full working order by the first of May.

THE TELEPHONE ON THE CONGO.—A telephone wire has recently been extended up the Congo from Boma to the mouth of the Kwa River, a distance of 450 miles. At present, owing to the feebleness of the electric current, it is impossible to talk over the wire the whole distance between Boma and Kwamouth. The voices are heard between the two points, but the words cannot be distinguished. It is necessary therefore to relay the telephonic message at Tumba, about two-thirds of the way from Boma. This delays the conversation but very little, and in ten minutes it is found that considerable interchange of remarks may be made between the capital and the up-river station. Every word is distinctly audible with this single break in direct communication.

SOUTH NORWALK, CONN.—The board of electrical commissioners of South Norwalk have recently issued their annual report on the municipal plant so admirably conducted by one of their number, Mr. A. E. Winchester, E. E. The board is now operating both street and commercial service. Of arcs it had in use on the average during the year 98 and it had 2299 incandescents connected. The total kilowatt-hours output for the year were 180,793. The average rate per hour received was $.0614; the average cost per kilowatt-hour, interest and depreciation included, was $.0579, and the average cost per kilowatt-hour, excluding interest and depreciation, was $.0405. These figures make an excellent showing and are very creditable to the management.

DEVELOPMENT OF SUSQUEHANNA RIVER POWER.—It is estimated that it will cost $7,000,000 to complete the proposed development of the power of the Susquehanna River in Maryland and Pennsylvania. The plans have been designed and worked out by James H. Harlow & Company, hydraulic engineers, of Pittsburg, and have been approved by Dr. Coleman Sellers, Clemens Herschel and John Bogart. Dr. Louis Duncan, of Baltimore, has made a report on the electrical features of the enterprise. The proposed developments include a low dam in the river in Pennsylvania and the building of an embankment to a point in Maryland three miles south of the Pennsylvania line, where the water in the race will be forty feet above the river bed. It is proposed to erect here a power house with a capacity of 40,000-hp under normal flow of the river. A second power plant of the same capacity is also included in the plan. The enterprise is being forwarded by the Susquehanna Electric Power Company.

THE PACIFIC CABLE.—Of the several cable bills before Congress, one appropriating $3,000,000 for a submarine telegraph cable from San Francisco to Honolulu was on March 20 favorably reported to the Senate by the Committee on Naval Affairs. The bill states it to be the purpose hereafter to extend the cable to Manila. It authorizes the Secretary of the Navy to enter into contracts for the cable and to use vessels of the navy for laying it if that is thought expedient. The cable, instruments, etc., are to be of American manufacture if the cost is not 12 per cent. greater than that of like materials in the foreign markets. When completed the cable is to be operated by the Post Office Department. A bill is before the House of Representatives contemplating a cable laid by private enterprise, on the strength of a contract with the government for the transmission of its messages, the government to have the right to take possession of the line and operate it in case of war or other national emergency. A minority report from the committee offers an alternative bill for a government cable.

GOOD ROADS.—The National Assembly of the League of American Wheelmen has strongly indorsed the bill presented to Congress calling for an appropriation of $5,000,000 for highway improvement in the various states. The bill is framed in the interests of farmers, wheelmen, automobilists and the public generally, and the League has requested in its resolutions that all classes support the bill by communication with their representatives in Congress, asking them to vote for the measure. In the debate which followed the introduction of the resolution many strong reasons for its passage were brought out. Among them was the fact that Congress annually appropriates millions of dollars for river and harbor improvement; that subsidies have been given for railroad building and for steamships. All of these, it was stated, are forms of highways, yet the national government has done nothing for a half century for better road highways, which would directly benefit the farmers and indirectly be of untold value to the commerce of the entire country.

SCIENCE ABSTRACTS.—*Science Abstracts* starts on its third volume with a reputation solidly established as an invaluable aid to those who desire to have inclusive knowledge concerning the current periodical literature of the world in the branches of physics and electrical engineering. The first volume—that of 1898—contains 740 pages, which are increased to 878 in the volume of last year. The latter volume contains an even 2000 abstracts, and the first number of the present year 441, which gives promise of a still larger volume for 1900. The list of journals abstracted contains 117 titles, and seems to be totally inclusive of all the leading scientific and electrotechnical journals of the world dealing wholly or in part with the branches of physics and electrical engineering. A valuable feature of *Science Abstracts* is the excellent manner in which it covers electrotechnical contributions to the engineering and electrical press, which makes the publication as useful to the engineer as to the professed scientist. With the January number of this year steam plants, gas and oil engines, and automobiles are added to the list of subjects to be covered by abstracts. The publication is issued monthly under the direction of the British Institution of Electrical Engineers and the Physical Society, of London, at a subscription price of $6 per annum. The American representatives of the publishers are Spon & Chamberlain, 12 Cortlandt Street, New York.

STORAGE BATTERIES.—Among the patents of March 27 are two on storage batteries, one issued to W. L. Silvey and the other to Henry Blumenburg and F. C. Overbury. The first-mentioned relates to filling for a perforated or grid plate. The filling is formed by dividing metallic lead in a fine powder known as "lead dust," which is much more readily acted upon than a solid mass of lead. The powdered lead is mixed in the dry state with finely ground sulphate of soda, and a paste of the mixture is made by the addition of water. The plate is then filled with this mixture and dried, during which process the sulphuric acid of the sulphate acts upon the metallic lead particles to bind them together. After the plate has been exposed to the air and dried for a time, it becomes covered with a white deposit of sulphate of soda mixed with sulphate of lead, which former is dissolved by washing the plate in water. This leaves the plates in a porous condition, after-which they are pickled in sulphuric acid and then, after drying, are ready for charging. The second patent relates to a lead electrode immersed in an acid solution, such as sulphuric acid, and a zinc electrode immersed in a solution of bisulphate of soda contained in a porous jar immersed in the acid solution. It is claimed that the alkali bisulphate solution prevents the zinc being acted upon and reduced to sulphate with unnecessary rapidity; and that while the battery is being charged the peroxide of lead is rapidly developed, there being action and reaction in charging and discharging between the alkaline bisulphate in the one cell and the acid solution in the other cell in addition to the action and reaction upon the zinc or similar electrode.

LETTERS TO THE EDITORS.

Rationalization of Electrical Units.

To the Editors of Electrical World and Engineer:

Sirs:—I beg to thank you for asking an expression of my opinion as to the points brought forward in the very interesting article of Prof. Fessenden, which appears in your issue of February 24. Unhappily, for some years I have been so absorbed in experimental work that I have not been able to follow closely the evolution of ideas relating to the theory of units, concerning which subject I have consequently to confess a lack of competency. However, I can say that, while rendering homage to the brilliant work of Mr. Heaviside, with the great majority of electricians I think that formidable opposition would be encountered by any movement toward the realization of his ideas in the definition of electrical units.

Without doubt, our present system is not without its faults. It

is a legacy to us from a past not yet far distant, when quantities of electricity and magnetism were spoken of as if they had a physical existence, while in the present state of our evolution it is the conception of *field* which predominates. The latter is certainly the more general, and possesses, aside from advantages of form, that of correspondence with an object having a physical reality less contestable. But does not one return to an arbitrary interpretation when he speaks of an isolated line of force, or of a number of lines of force? I am aware that such language deceives no one, and that there is no electrician past 20 years of age who believes in the existence of an isolated line of force, while formerly many believed in quantities of magnetism and often in "magnetic masses." Nevertheless, it should be recognized that from this standpoint our terminology is not yet in complete accord with our ideas.

Our present system of units are daily subject to other reproaches. The practical units adopted twenty years ago were really practical at that epoch; but to-day they are in general, with the exception of the farad, too small for the industry and too large for the laboratory. On the one hand the fourth and fifth power of ten occur too frequently; on the other hand, the factors 10^{-10} to 10^{-12} are too often met with. This has already led to the proposition, more and more frequently brought forward, to return purely and simply to the C. G. S. system, or to adopt prefixes indicating in multiples of three, positive and negative powers of ten. That this reform will come to pass I do not doubt, but it will be easy in proportion as it is ripe, and as the differences with respect to the practical units are greater. It is then, I think, and only then, that it will be possible to come to the rational units of Mr. Heaviside, or to the partially rational units of Prof. Fessenden.

At any rate, the importance of this transformation should not be overrated. In reality, there are few theoreticians who suffer from the faults of our present units, with which they have little to do; and the practical men who may have been taught their derivation, forget it in the course of a few years. If it were a question, however, of introducing the rational units of Heaviside in electrotechnics, the disturbance resulting would outweigh the advantages of the transformation. It seems to me that a condition of sufficient rigor for an electrical system of units is coherence between them and the units of energy.

I would insist, in addition on a little detail—the necessity more and more evident, of substituting conductances for resistances and mhos for ohms. The advantages of this change would be sensible in the laboratory, but would be especially great in the industry, the conductance giving directly the technical value of a distributing system. Our system of resistances is analogous to one which would evaluate the qualities of a machine in terms of the time it employs to effect a given work. No one, I believe, has ever thought of doing this.

I will conclude by giving several indications concerning the international congresses now having their programmes organized. If my information is exact, the Committee of the Congress of Electricians has definitively left out the question of units, which, it will be recalled, so greatly encumbered the disposal of the programmes of preceding congresses. On the other hand, the Committee of the Physical Congress, of which the complete programme will soon be made public, will give a place to this question and seek to excite an interest in it with a view to future action. In any case, it seems advisable to submit to discussion the propositions of Prof. Fessenden, not with a view to deliberating on their fate, but to bring them to the attention of the interested in other countries and to prepare for their eventual adoption in a succeeding congress, if their advantage should come to be sufficiently evident to warrant the necessary change in the present system.

Sevres, France. Ch. Ed. Guillaume.

Induction Motors for Electric Railways.

To the Editors of Electrical World and Engineer:

Sirs:—Referring to the editorial in your issue of February 10, and to Mr. George T. Hanchett's letter in a following issue, I perfectly agree with Mr. Hanchett's opinion that at present the only successful application of the induction motor is for interurban work, but would add that in my opinion the polyphase induction motor, especially the three-phase motor, will have the field against the direct-current motor for electric interurban and trunk line service. The chief reason why the induction motor will at present not supersede the direct-current motor in street railway service lies mainly in its requirement of two or three trolleys, which with the overhead trolley system now almost exclusively in use, is out of the question for larger cities. But with a practical surface contact or slot conduit system, the induction motor will come to the front in larger cities, where the ordinary 500 or 600-volt direct-current distribution will soon be a thing of the past, being now rapidly replaced by three-phase distribution with rotary trnnsformer substations.

I do not think that the lag between current and e. m. f. in modern induction motors is a serious matter. A few years ago, when induction motors of medium size up to 25-hp were designed with a power factor as low as 0.85 to 0.80 at full load, dropping rapidly at half loads to 0.7 or even 0.6, this was a serious objection against using such a motor for railway work. But with our present knowledge of the principles of the design of induction motors, we can make motors with a power factor of 0.9 at full and half loads, without making the air-gap too small. This 10 per cent. increase in feeder drop is quite insignificant, if one stops to consider that the direct-current railway feeders usually have to be calculated for at total drop from 7 to 10 and even more per cent., whilst with a three-phase high pressure transformer distribution this drop may be easily reduced to 2 or 5 per cent.

The effect of the lagging currents upon transformers and generators is nowadays not to be considered at all, because we know now exactly how to design a good transformer and generator whose efficiency and pressure regulation will not be considerably affected by the lagging current. Small armature reaction with a correct disposition of coils, a strong magnetic field with small leakage and proper design of the poles, and a good short circuit characteristic are the points which are now quite familiar as to their effects upon the design of an alternator to every designer of modern electric machinery. I therefore do not think it will be even worth while to trouble with high-voltage condensers, in which the possible immense rise of voltage will always be a source of trouble, not even considering their first cost, maintenance and the large space they require. For a plant of several thousand horse power capacity special condenser houses would probably have to be built, if the condensers are to be safe and large enough to give the desired effect.

As to the question of clearance in induction motors, I wish to point out that in these motors the air-gap induction is by far smaller than in the standard direct-current railway motor. Gap densities up to 4500 are the rule with induction motors, whilst 8000 to 10,000 are used with railway motors of the direct-current type. As the side pull between the rotor and an eccentric stator increases with the square of these densities, it is evident that the danger of the rotor-surface rubbing against the surface of stator is considerably reduced with induction motors, even if the clearance be comparatively small, and especially with strong armature shafts. There is a tendency now in designing induction motors to increase this gap, but without interfering with the power factor, by a liberal use of copper in the primary winding. Thus a good railway induction motor of 30-hp may be designed with a clearance of one-tenth of an inch, which, if well designed bearings and strong shafts are used, ought to be sufficient to prevent rubbing for several years.

As to the speed of an induction motor for traction, Mr. Hanchett has stated the case correctly in his example. I only would say that a motor with a diameter of rotor of 22 inches and 500 r. p. m. at 25 *0* would have a considerably larger power than ordinarily required for motor cars.

As to an economical speed regulation, I should point out that with induction motors the regulation is not exclusively limited to the ordinary method of inserting resistances into the circuit of the secondary windings, which certainly is not economical. A method which I, for instance, have applied successfully in crane work, is to halve or double the number of poles produced by the windings of the rotor and stator, thus obtaining half or full speed of the motors economically without resistances. If between these two main speeds resistances are inserted in the secondary circuit in order to obtain a gradual speed regulation, such a method will be nearly equivalent to the usual series-parallel method of control of direct-current railway motors.

Emil Kolben.

Prague-Vysocan, Austria.

Motors for Electric Automobiles.

To the Editors of Electrical World and Engineer:

Sirs:—In an article on motors for electric automobiles in your issue of March 10, Mr. P. M. Heldt states that motors with both armature and fields revolving have some important advantages. This is true, but in explaining the advantages he names some that do not exist and omits others.

It is true that the output of a certain size and type of motor of fixed voltage may be somewhat increased by properly winding the armature and fields for double the relative velocity, but it cannot by any means be doubled if the heating limits are to remain the same. In order to get the higher relative velocity the torque must be reduced to practically one-half its former value, and the sum of the armature torque and field torque is about what the torque of the armature alone was in the first case. As the absolute angular velocity has not been changed, the gears remain the same, and the starting torque, impressed on the driving wheels, remains the same. Even if the output could be doubled, as stated, the starting torque would only be doubled. The double starting torque is due to double output and not to the fact that both members revolve.

The chief advantage of the revolving field type is that it dispenses with the differential gear, at the same time reducing the ratio of gear reduction to one-half if the relative velocity of armature and fields is kept the same. If the relative velocity is doubled, the weight of the motor may be reduced somewhat. A combination of the two (raising speed some and lowering reduction some) might be advantageous.

R. J. OCHSNER.

CHICAGO, ILL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternators Connected in Parallel.—GOERGES.—A long theoretical article, illustrated with many diagrams, giving a simple graphical representation of the action of alternators connected in parallel, and an analytical theory of the oscillations, including the subject of damping, as promised in the preliminary article noticed in the Digest Feb. 3. He reaches the following conclusions. For the behavior of alternators connected in parallel, the degree of lack of uniformity in one revolution of the machine, is less important than the maximum value of the lead or lag of any point of the rotating part, before or behind that position in which it would be at the same instant if the speed in each revolution were uniform. The value of this lead or lag determines the variation of the power and current of the machine in parallel; therefore this lag or lead must be below a certain value. This is the case, if, under consideration of the "resonance modulus" (a term in his equations which measures the degree of resonance), the degree of lack of uniformity in one revolution is below a certain value, which is dependent upon the conditions of working of the driving machine. If, for instance, the moment has one maximum and one minimum during one revolution, the degree of lack of uniformity in one revolution must be very small; it will be greater, the more there are maxima and minima in one revolution. To prevent the danger of resonance, it is advantageous to use such driving machines, for which the variation of the moment during one revolution consists of several, nearly equal periods. In this case the periodicity of the driving machine will as a rule be much greater than that of the dynamo. If besides, there is a greater moment of inertia, good parallel running without special damping, is easily obtained in general. If the tangential pressure diagram of the driving machine is known, for a given maximum value of lag and lead, it is easy to calculate the necessary moment of inertia. It is found that the moment of inertia is to be chosen inversely proportional to the square of the periodicity of the driving machine. The electrician must therefore not be satisfied with a certain degree of lack of uniformity in one revolution, but must consider the tangential pressure diagram in order to have a safe starting point for further calculations.—*Elek. Zeit.*, March 8.

Weight Economy of Dynamos.—ROSENBERG.—A brief abstract of a paper read before the Electrotechnical Society of Vienna, in which he investigated the conditions in which a minimum of weight and price of a dynamo may be obtained. He discussed the means of preventing sparks which have a great influence upon the weight of a machine, and Seidenberg's method of diminishing the armature reaction, based upon a series winding applied to the magnet cores; also Deri's system of compensation windings. He believes that a good economy of weight of continuous current dynamos is to be obtained not by the use of more suitable materials, but by diminution of the armature reaction.—*Elek. Zeit.*, Feb. 22.

Theory of Alternating Current Machines.—BRESLAUER.—An abstract of a paper read before the Electrotechnical Society of Vienna, on the application of Heyland's diagram in practice. The maximum power factor of induction motors depends only upon the straying, but not on the current at no load. He concluded from his curves that it is very improbable that a higher power factor can be obtained for induction motors than 0.9. The practicability of the use of the graphical method is shown by some examples.—*Elek. Zeit.*, Feb. 22; *Zeit. fuer Elek.*, Feb. 18.

NIETHAMER.—A brief communication referring to the above paper by Breslauer. He claims that it is not difficult to obtain a power factor of 0.92 to 0.96 for induction motors. He has previously shown that the maximum power factor is determined when the iron dimensions, i. e., the form and the number of slots, are given; it is independent of the induction, the air gap, etc., when the average induction in the iron is not exceedingly high.—*Elek. Zeit.*, March 8.

LIGHTS AND LIGHTING.

Arc Lamps.—BOCHET.—A paper read before the International Society of Electricians in Paris, discussing some new systems of operating arc lamps at low e. m. f., especially three arcs in series without resistance, between 110 to 120 volt mains (Digest, Oct. 14, Nov. 18, Feb. 3.) He concluded that each arc lamp system can be operated at low differences of potential, if special carbons are used. In general it is well "to leave a margin between the total difference of potential and the difference of potential at the terminals of the lamps." In the discussion which followed, Rouse said that the operation of three arc lamps in series is economical in special cases as in private installations where voltages of 115 to 120 are available. He referred to an installation of 14 arcs in Paris, comprising four groups, each of three arcs in series, besides two directly between 110 volts; these lamps operate well, and it is difficult to see a difference between them, the luminosity being the same and constant; there is a very marked influence due to the type of carbons used. Brillie has operated five lamps between 220 volts; he said that for a current over 8 amperes, all carbons are good, but below this current it is necessary to make experiments with different sorts of carbon.—*L'Ind. Elec.*, Feb. 25; *L'Eclairage Elec.*, Feb. 17.

Costs of Operating Arc Lamps.—An editorial stating that according to the figure of Ellicott, the city electrician of Chicago, the average cost of operating 2000 c. p. arc lamps by the Bureau of Municipal Lighting was $55.93 in 1899. If, however, additional elements of cost are taken into account, which seem to be perfectly fair and reasonable, this cost is increased to $90.98.—*West Elec.*, March 24.

POWER.

REFERENCES.

Lifting Apparatus.—EGGER.—An abstract of a paper read before the Electrotechnical Society of Vienna, describing the electric lifting apparatus, used on a station of the Vienna Tramways, for lifting the cars 17 feet. A 40-hp. continuous current shunt motor is used.—*Elek. Zeit.*, Feb. 22; *Zeit. fuer Elek.*, Feb. 25.

Blast Furnace Gases.—DEMENGE.—Two long illustrated articles on the utilization of blast furnace gases. In the first he discusses the general principle of the system, in the second the engines which are practical for that purpose.—*Rev. Gen. des. Sc.*, Feb. 15, 28.

Electric Crane and Motor Car.—A brief illustrated description of a combined crane and car, both worked by electricity, of the Brill Co. of Philadelphia.—*Railr. Gaz.,* March 23.

TRACTION.

Electric Trunk Railways.—NEUDECK.—An article on recent installations of electric railways in Italy (see also Digest, Nov. 11, 18). On the line from Milano to Monza, which has a length of 8 miles with only slight grades, accumulators are used. Each motor car has two batteries, consisting of 65 cells; each cell has 11 positive and 12 negative plates; the positive Planté plate has an active surface eight times greater than the apparent surface; the weight of each cell is 231 lbs., the total weight of batteries and cases is 39,600 lbs. The capacity is sufficient for two round trips without recharge. The total weight of a car without passengers is 127,600 lbs. The energy consumed per ton mile is 41½ kw-hours. The e. m. f. is 275 volts at start and 260 to 265 volts after two round trips; at trials with three round trips the voltage decreased to 1.8 volts per cell. The accumulators are recharged, while on the car, in about 90 minutes. On the line from Milano to Laveno, which has a length of 70 miles, the third rail system is to be used. Three phase current at 13,000 volts is transmitted to six synchronous converter substations, equipped with accumulator batteries, and transformed into direct current of 500 to 800 volts. On the line from Bologna to San Felice, which has a length of 25 miles with only slight grades, Pescetto accumulators are used. The capacity is sufficient for one round trip. The line between Lecco, Colico, Sondrio and Chiavenna, which has a total length of 70 miles, is to be operated directly with the three phase system. Water power is used to generate three phase current at 15,000 volts, which is transformed in ten transformer substations along the line down to 3000 volts. The current is supplied to the motor cars by two overhead wires, 2.85 feet apart, the third conductor of the three phase system being the rail. This is said to be the first time that railways are operated at such high alternating current voltages. A block system is used. Each motor car has four three-phase motors. In general two motors drive the car; on considerable grades the other two motors also drive, being supplied with current, not from the trolley, but with that generated in the armatures of the first two motors; by this method the speed is reduced to one-half without loss of energy, which is explained. The normal speed is 36 miles per hour for passenger trains, and 18 miles for freight trains, and is reduced to 18 and 9 miles respectively on grades of more than 1 per cent. The passenger trains consist of one motor car and one trailer. The maximum load of the freight trains is 200 tons.—*Zeit. fuer Elek.,* Feb. 25, March 4.

Telpherage.—Some editorial notes, calling attention to the editorial in the ELEC. WORLD AND ENG., Feb. 17. The technical difficulties are now no longer insurmountable and the problem is merely a financial one, in the question whether telpherage will pay as a rival to mechanical funicular haulage. For the following particular uses telpherage is thought to be applicable to advantage; for the conveyance of minerals from quarries to railway trucks; for temporary transportation; for the collection of agricultural produce from fields and its conveyance to the local electric railway station or siding.—Lond. *Elec.,* March 16.

Electromobiles in the Mail Service.—An article stating that the German mail department, after unsuccessful trials with a benzine automobile, now uses two electric automobiles for delivering packages, and that these trials appear to have been successful. One automobile weighs 6160 lbs., of which 4180 lbs. are the weight of the 42 accumulator cells, the motors, and the gearing; in the beginning of the trials the daily round trip covered 25 miles, while it now runs 36 miles per day. The other automobile weighs 3900 lbs., of which 1760 lbs. is the weight of the battery; the capacity is sufficient for a trip of 19 miles. The conclusion is drawn that electric automobiles will take an important part in the future mail service, but that further improvements are necessary before a general introduction is possible.—*Elek. Anz.,* Feb. 25.

Electric Motor Wheel.—A note describing very briefly the construction of an electric motor which is placed inside of the wheel of a car. The laminated armature core is built up on the inside of the wheel rim, which is made considerably broader than is at present necessary. The windings are sunk in the laminated core, the connections of the commutator being brought down to radial sections placed near the hub; the commutator thus has its surface in a plane at right angles to the axis of the motor. The field magnet system is built up on the fixed part of the frame, and is of the multipolar type. The brush gear is contained in the base of the field magnet system. Two bearings are required at each wheel. It is doubted whether the system is successful commercially.—Lond. *Elec. Eng.,* March 16.

Chicago.—An illustrated description of the power house of the South Side Elevated Railway at Chicago. Four 800-kw dynamos generate a current of 1455 amp. at 550 volts; all brushes of the same polarity being maintained at the same potential by a special arrangement. There are two batteries, each of 248 chloride accumulators, having a capacity of 700-hp when discharged in one hour. —*Elec. Rev.,* March 21.

REFERENCES.

Dangers of Trolley Wires.—A reprint of eight questions asked by the officials of the Lower Austrian government, relating to the dangers of the overhead wires of trolley lines, and the answers given by a committee of the Electrotechnical Society of Vienna, consisting of Frisch, Hochenegg and Sahulka.—*Zeit. fuer Elek.,* Feb. 18.

Philadelphia.—PERKINS.—A very brief, illustrated description of the Union Traction plant.—*El'ty,* March 28.

Automobiles.—BERTHIER.—An illustrated description of some French types of electric automobiles and front wheel frames with motors.—*Cosmos,* March 3.

American Street Railway Apparatus in England.—An illustrated description of the Brill trucks and Westinghouse Street Railway motors and controllers used in Hull.—*West. Elec.,* March 24.

Austria.—A table showing the traffic on the electric railways of Austria and Bosnia from October to December, 1899, and giving a comparison of the traffic and the receipts in 1899 and 1898.—*Zeit. fuer Elek.,* Feb. 25.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Electric Station Risks.—Low.—A short paper, read before the Fire Underwriters' Association of the Pacific. "Insurance managers may well look upon electrical risks with discerning eyes that punishment for the sins of the poor plants may not be inflicted upon the good ones." Proper electrical installation precludes every possibility of fire from electrical causes. Individual fireproof switchboards should be used for each machine or appliance, because of their greater safety; the causes of the destruction of two large stations in California during the past four months were traced to the use of composite switchboards. All mains and bus bars should be run in roomy fireproof subways. Lightning arresters should be installed in a special building, entirely apart from the power house. Transformers containing oil may be placed either in a separate building or partitioned off with a fire-wall. Means should be provided for shutting down any or all engines at once from a master device in case of fire or other capital emergency.—*Jour. of Elec.,* February.

Motor Coupling.—DOUGLAS.—An illustrated communication describing a simple latch coupling for motors and pulleys. Each pulley, having a bronze bushing, runs loose on the shaft, but is prevented from moving endwise by the latch collar which is secured to the end of the shaft by a key and a set-screw. The latch is a piece of ½-inch round steel sliding in this collar and engaging in any one of four holes drilled in the enlarged end of the pulley hub. To prevent the latch from moving accidentally, there is provided a bicycle ball, pressed outward by a spring, and entering either of the two slight countersinks in the latch. The ball and spring are placed in a little well drilled in the body of the collar.—*Amer. Mach.,* March 22.

Maximum Demand System.—Two communications, the first by Doherty, the second by Hale. The principle of the Wright maximum demand system is absolutely equitable only in the special case in which a station supplies only one customer. When several customers are supplied, no absolutely fair method of charging can be devised. The Wright system is not perfect since it does not take into account the practical difficulty of determining exactly which are operating expenses and which are standing-by charges. Also since it divides the saving due to the customer using their maximum demands at different times, between these customs. It is, however, by far the best system so far devised.—*West. Elec.,* March 3 and 24.

REFERENCES.

Circuit Breakers.—VEDOVELLI.—A brief abstract of a paper read before the International Society of Electricians in Paris, describing some types of circuit breakers for high voltages.—*L'Ind. Elec.,* Feb. 25; *L'Eclairage Elec.,* Feb. 17.

Regulations.—A reprint of the new legal regulations for electric low and high tension plants; also of the general rules for electric installations and of those for the feeders of electric tramways, in Switzerland.—*Elek. Zeit.,* March 1, 8, 15; a summary is given in an editorial of *Elek. Zeit.,* March 8.

WIRES, WIRING AND CONDUITS.

Cable Specifications.—An editorial on light and power cable specifications, which, from the buyer's point of view, are a matter of considerable interest. More attention should be directed to the copper core; there is a difference of 2 per cent. between Mathiessen's standard for soft annealed and hard-drawn copper wire; owing to the spiral lay of stranded cable, the actual area of stranded wires at any cross-section exceeds that of the same number of straight wires, the equivalent area must be taken as a certain percentage less than the sectional area of the same number of straight wires, so that there is occasionally a decided uncertainty how the specification of area is to be read, and as the increase in weight due to stranding is in the order of 1 per cent., there is an added uncertainty of 2 per cent., which is shown in a numerical example. For insulation tests a factor of safety of from 2 to 3 has usually been deemed sufficient, and this should not be exceeded, for although cables will frequently withstand even ten times the voltage for which they are designed, the application of this may occasion an injurious strain in the dielectric. Instead of specifying "non-hydroscopic insulation," the consultant should clearly describe a time test in water to which a sample of the cable, deprived of its lead covering, must be submitted. A very important omission in many specifications is a statement of the thickness of lead and iron sheathing.—Lond. *Elec.,* March 16.

REFERENCES.

Calculation of Networks.—HERZOG and FELDMANN.—A theoretical article, fully illustrated with diagrams, in which they describe a method for calculating a network; it is a physical analogy to the mathematical elimination of unknown terms from the linear equations which follow from Kirchhoff's rules. The network is successively changed or "transfigured" in such a way that less and less conductors and meshes remain. The method is based upon the graphical and analytical rules for the combination of impedances.—*Elek. Zeit.,* March 1.

ELECTRO-PHYSICS AND MAGNETISM.

Electric Touch.—BROWN.—A communication referring to the paper of Bose (Digest, March 24). He does not like to discard the old idea of electrically produced cohesion in order to substitute Bose's theory of molecular changes produced by electric waves. He thinks it may be found in many cases that when any chemical action has taken place, the cause is not so much the Hertz waves as the effect of the current from the local circuit usually employed to detect the cohering action of such waves. Starting from his theoretical ideas he has invented three new coherers.—In an editorial note it is thought that his success in constructing coherers from his preconceived ideas, cannot in this case be regarded as supporting the ideas themselves.—Lond. *Elec.,* March 9.

A Gas in an Electric Field.—WALKER.—A brief abstract of a Physical Society paper, in which he treats mathematically the distribution of the gas ions in an electric field. The analysis leads to the conclusion that the distance between the striæ is inversely proportional to the density of the gas and to the current strength, and these facts have been experimentally proved.—Lond. *Elec., Elec. Eng.,* March 16.

Röntgen Rays for Examining Coal.—A long abstract of a communication of Prof. Courot to the Society of Mineral Industry in St. Etienne, France, on the use of Röntgen rays in the estimation of the impurities in coal. The method is based upon the fact that Röntgen rays traverse such hydrocarbons as wood and such an element as the diamond, while silicate of aluminum or silica are opaque to them, as previously noticed in the Digest. His apparatus is described at some length and several of his radiographs of various coals and products are reproduced. "As this method of analysis does not reveal the condition in which the carbon exists, and as it is impossible to determine the percentage of sulphur while approximating the amount of ash, it would seem to have greater scientific than technical value."—*Eng. & Min. Jour.,* March 17.

Fluorescent Screens.—PRECHT.—An account of an investigation of the time effect in some fluorescent screens in tubes used for Röntgen ray work; the bones of the hand, for instance, are not visible at once on the screen. He studied the time effect both in sulphide and in platino cyanide screens. He finds that the time required for the true development of the radioscopic picture is on the whole shortest at the highest discharge potential. It varies from a few seconds to a minute.—*Ann. der Physik,* February; abstracted in Lond. *Elec.,* March 9.

Atmospheric Electricity.—SCHWALBE.—An account of experiments showing that hot water evaporating from a metallic dish does not carry off any perceptible portion of the charge of that dish. He tries to explain Pellat's contradictory results. Schwalbe's results appear to disprove Exner's theory that atmospheric electrification is chiefly due to the fact that large bodies of water, in evaporating, lose the charge they possess and communicate it to the atmosphere.—*Ann. der Physik.,* February; abstracted in Lond. *Elec.,* March 16.

Serpentine Lightning.—KALES.—A description of what he considers a newly observed form of lightning. The observations were made at Franklinville, N. Y. A flash from west to east was in the upper air, the color was light yellow, the movement slow, and the appearance that of an immense boa constrictor. The varying resistance of the atmosphere may account for the various forms of lightning observed. When the lightning appears in vertical purple chains destruction is sure to follow; the air is dry and the resistance great on these occasions.—*West. Elec.,* March 3, 24.

New Magneto-optic Effect.—DONGIER.—An account of experiments showing a partial polarization of the light emitted by vacuum tubes under the influence of a magnetic screen. It is best observed in the case of red rays emitted by hydrogen under the spark discharge. The greatest proportion of polarized light is found in the direction normal to both the tube and the field. There are two such directions, and they again differ in optical properties among themselves. That direction shows the maximum of polarized light which is such that the observer can by a right-handed rotation of 90° bring the vector representing the magnetic field into coincidence with the vector of the electric field inside of the tube.—*Comptes Rendus,* Jan. 29; *L'Ind. Elec.,* Feb. 25; abstracted in Lond. *Elec.,* March 9.

REFERENCES.

Electricity and Magnetism.—FESSENDEN.—The second concluding part of his long paper, the first part of which was abstracted in the Digest Feb. 10. He gives a summary and the conclusions, the most important of which were already noticed. In three appendices he investigates the relation between magnetic permeability and magnetizing force, gives a summary of previous work, and discusses the nomenclature, symbols and units.—*Phys. Rev.,* February.

Masses Smaller Than Atoms.—An article on "the downfall of the atomic theory," based upon the paper of J. J. Thomson, noticed in the Digest Oct. 14 and Dec. 30.—Lond. *Elec. Rev.,* March 2.

Geissler Tubes.—MORRIS-AIRY.—A short illustrated article in which he shows that an experiment of J. J. Thomson, alleged to show the convection of chlorine through hydrogen under the influence of an electric discharge is not sufficient proof for such a convection.—*Phil. Mag.,* March.

Becquerel Rays.—A reprint of the illustrated English article, noticed in the Digest March 31.—*El'ty,* March 28.

Lichtenberg's Figures Inside of Vacuum Tubes.—RIECKE.—An account of a continuation of his investigation of the distribution of surface charges on vacuum tubes by means of Lichtenberg figures (Digest, Feb. 10). He found that these figures can be seen, without the help of sulphur and red lead, by closely observing the structure of the various fluorescent patches.—*Ann. der Physik,* February; abstracted in Lond. *Elec.,* March 9.

Atmospheric Electricity.—A brief general outline of some recent investigations and theories.—*Elek. Anz.,* Feb. 15, 18.

Half-Ring Electromagnet.—DU BOIS.—An abstract, with illustrations, of the article noticed in the Digest Feb. 24.—*Elek. Zeit.,* March 1.

ELECTRO-CHEMISTRY AND BATTERIES.

Electric Furnace for Producing Calcium Carbide.—CARLSON.—The conclusion of his long article (Digest, March 17). By a thermodynamical method he determines the difference of the outputs of furnaces operated continuously and of such with interrupted runs, and finds that the theoretical maximum output of a continuously operated furnace cannot be above 75 per cent. of a furnace used with interrupted runs. In the latter it is possible to produce about 20 per cent. more carbide of 86 per cent. purity, than of 76 per cent. purity in a continuously operated furnace. In the latter, and in general in

all furnaces, in which the carbide is to be brought into liquid form, it is quite impossible to reach approximately the maximum theoretical output. That the output of furnaces with interrupted runs is greater than that of continuously operated ones, has been proved also by practice. He concludes that the methods of producing calcium carbide are far from perfect. In the best designed furnaces the actual output is about 60 per cent. of the theoretical. The calcium carbide industry is therefore capable of improvements in both the design of furnaces and the method of smelting. The furnace to be used in future for producing calcium carbide will not be a resistance but an arc furnace and will be operated with interrupted runs.—*Zeit. fuer Elektrochemie,* Feb. 15.

Accumulators.—M. U. SCHOOP.—An illustrated article giving the results of experiments made to determine the relation between capacity and rate of discharge for different accumulators. He sums up his results as follows: In spite of the good specific conductivity of spongy lead, plates of spongy lead, including formed as well as pasted plates, are more sensitive to an increase of the discharge current than plates of peroxide of lead, for equal "absolute" capacity, i. e., that capacity which relates to a very small discharge current. The behavior of a formed cathode (presumably meaning the spongy lead plate) is not essentially different from that of a pasted cathode as to capacity and e. m. f., as far as only the first 10 to 25 discharges and charges are considered; in practice formed cathodes should not be used, because they lose their capacity very quickly. The active material of a formed plate is better utilized than that of a pasted plate; in general, however, the grid electrode has a far better ability of "recovering" than the formed electrode. For most systems it is to be recommended to make the capacity of the cathode somewhat greater than of the anode, especially if the accumulator is to be used for greatly varying loads, as in storage batteries, and if large currents for short intervals are used, as in automobiles.—*Zeit. fuer Elek.*, Feb. 18.

Portable Accumulators and Adjustable Resistances.—An illustrated description of portable accumulators of English make for medical work. A battery of six cells with a capacity of 30 ampere-hours is said to be most useful for such purposes. A handy form of variable resistances is also described and illustrated. It is made of a series of carbon discs interleaved with discs of metal, which are slightly bent so as to maintain a spring pressure on the carbons. A screw on one end with a very fine thread enables a fine adjustment to be made. The metal and carbon discs are enclosed in a vulcanized fibre envelope pierced with holes for the escape of the heat. The addition of the metal discs enables a wide range of resistances to be obtained. To facilitate the charging of the accumulators a charging board has been introduced, with four terminals, two for connection to the charging mains and two for the battery; an incandescent lamp in the middle of the board is first connected in series with the accumulators. When the charging mains have been connected, the terminals for the battery connection should first be short circuited, and then a small needle between these terminals indicates which of them should be connected to the positive terminal of the battery. This combination of a pole indicator with the lamp resistance makes it an easy matter to connect up the accumulators in the right way for charging.—Lond. *Elec. Eng.*, March 9.

Improved Primary Cells.—A note describing an improved Leclanché cell of Siemens & Halske. Within a rectangular or cylindrical cardboard vessel is inserted a zinc vessel of similar shape, whose bottom is either made of zinc or of asphalt material firmly united to the zinc sides so as to prevent any escape of liquid. Within this zinc vessel is placed the carbon electrode, which is surrounded by a porous depolarizing mass secured to it by a gauze bag. The electrolyte, which consists of a concentrated solution of sal ammoniac, is contained in the interspace between the carbon electrode and the zinc vessel, and is sealed hermetically with a layer of asphalt, so that the gases generated while working can only escape into the atmosphere through a gas chamber in the upper part of the cell by passing through the porous depolarizing material, on which their passage has a continuous loosening action. The gas chamber is filled with rice husks, and above this is a layer of asphalt, which closes the cell and secures all parts permanently in their relative positions, while small capillary glass tubes passing down into the husks through this layer, allow the escape of gas but not of liquid. A vulcanite tube, cemented into the top layer of asphalt and secured by a cover, extends into the lower chamber, and serves for the introduction or removal of the electrolyte. Pfannenberg's reform cell (Digest, March 10) is also described.—Lond. *Elec.*, March 9.

Primary Cell.—PEDRONI.—A description of a new cell of the Daniell type. It is claimed to have a low internal resistance and constant potential when at work. With 20 cells he got 22 volts. When connected to a resistance of 13 ohms for 888 hours he still got 1.08 volts per cell, without a variation of more than 1-100 volts. He claims that with his arrangement the sulphate of copper solution is entirely prevented from getting at the zinc, and that this accounts for the good results obtained with the battery. He estimates that the current for a 10-cp lamp would not cost more than 2 cents per hour.—*Revue d'Elec.*; abstracted in Lond. *Elec. Eng.*, March 9.

Sterilization of Wine.—A note describing a method devised by Meritens by which all microbes in wine are killed in a few seconds by the application of alternating currents of high frequency and low potential which at the same time conduces to preserve the wine. His apparatus consists of a narrow glass tube through which the wine to be treated passes; inside the tube there is a series of insulated metallic discs, connected to a source of alternating current. The speed of the liquid is regulated by a valve, so that it can be subjected to the action of the current for any given time. The invention is said to have proved of considerable commercial value.—*El Telegrafista Espanol*; abstracted in Lond. *Elec. Eng.*, Feb. 16.

REFERENCES.

Electrochemistry.—FOERSTER.—An article discussing the question of what place electrochemistry should have in the study of chemistry in universities.—*Zeit. fuer Elektrochemie,* March 1.

Induline.—LOEB.—A preliminary description of an electrolytic method of producing coloring matter of the induline type.—*Zeit. fuer Elektrochemie,* Feb. 22.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Damping of Galvanometer Needles.—SOLOMON.—An abstract of a British Physical Society paper, giving an account of experiments made to discover the cause of the variation of the ratio of the period to the logarithmic decrement, which ratio, according to the theory, should be constant and is simply a function of the damping coefficient and the moment of inertia of the moving system. He found that these variations are caused by variations of the damping coefficient due to eddy currents, as there are alternations in the strength of the swinging needle produced by altering the strength of the controlling field.—Lond. *Elec., Elec. Eng.*, March 16.

Return Currents of Tramways and Measurements of Terrestrial Magnetism.—EDLER.—An account of a long series of measurements made to find the effect of the return currents of tramways upon measurements of the horizontal intensity of terrestrial magnetism (see the abstract of the paper of Bezold, Digest March 31). The article is illustrated with diagrams. From his measurements, he finds that under certain restrictions and for a straight tramway line, the distance may be calculated at which a tramway line causes a disturbing influence upon a magnetic observatory. Under certain suppositions for a distance of five miles, the average horizontal disturbance is 0.47 j, where j is 0.00001 C. G. S.; the absolute maximum disturbance would be two or three times as great. In Greenwich, Washington and Toronto the disturbances were even greater. —*Elek Zeit.*, March 8.

Surface Tension.—PHILLIPS.—A brief abstract of a British Physical Society paper, describing a lecture experiment in which he exhibits the effects of surface tensions by placing water between two pieces of microscope cover glass. When the glasses are circular they take no definite position; when square or elliptical they get into a definite position to which, if displaced, they immediately return. He pointed out how two circular discs with liquid between could be used for suspending the moving system of a galvanometer. In the discussion it was suggested to use some liquid which would evaporate less slowly than water.—Lond. *Elec., Elec. Eng.*, March 16.

REFERENCES.

Alternating Current Meter.—E. H.—An illustrated article on the Batault meter, which was described in the Digest Dec. 30.—*L'Ind. Elec.*, Feb. 25.

Standard Cells.—BOSE.—An illustrated description of a practical form of standard cells and electrodes, which is said to have proved very satisfactory for electrochemical measurements. They are made with the ordinary exsiccative vessels.—*Zeit. fuer Elektrochemie,* March 1.

Testing Meters for Three-wire Systems.—MAREK.—An illustrated description of a method of testing very quickly a large number of meters for three or five-wire systems, with an accuracy which is sufficient for practice.—*Elek. Zeit.,* March 1.

Plotting Hysteresis Loops.—ANGSTROM.—An illustrated full translation of the Swedish Academy paper, an abstract of which was noticed in the Digest Jan. 27.—*Phys. Rev.,* February.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wheatstone Automatic Telegraph Apparatus.—An illustrated description of some improvements devised by Willmot, in order to diminish wear and tear. In the transmitter he substitutes a permanent magnet for the spring and jockey roller now used for holding over the vibrating contact lever. He also substitutes properly pivoted crossheads for the hole and pin joints of the horizontal levers and arranges the screw adjustments so as to permit of easy and convenient access. Another improvement relates to the perforators, the punches of which require frequent sharpening; his punch has a hollow recess at its end and no centre on which a deposit of oil from the oiled paper can take place; the surface of the punch therefore remains flat and makes a clean perforation. These punches are also easily ground.—Lond. *Elec. Rev.,* March 2; reprinted in *El'ty,* March 28.

REFERENCES.

Telegraphy and Telephony.—An article on progress in telegraphy and telephony from October to December, 1899, giving brief descriptions of improvements taken from patent specifications.—*Elek. Anz.,* Feb. 15.

Block Signals.—BALLIET.—A paper read before the Railway Signaling Club, on the maintenance and inspection of automatic electric block signals.—*El'ty,* March 21.

Electric Indicators.—An illustrated description of the electric indicators or signboards in the Boston Subway, by means of which the passenger is notified from 45 to 90 seconds in advance at which section or "berth" his car will stop.—*Railr. Gaz.,* March 23.

MISCELLANEOUS.

Electrical Treatment of Tuberculosis.—DOUMER.—A French Academy paper stating that a continued application of d'Arsonval's high frequency current method to the treatment of pulmonary tuberculosis has a very good effect in the earlier stages of the disease. The treatment consists of the high-frequency brush discharge to the surface of the skin just above the diseased tissue for about five minutes per day. Sparks are not painful. The various symptoms of the disease disappear one after the other. The last symptoms are the stethoscopic sounds which are not usually arrested till after six or eight months of treatment. Seventeen cases in all were treated, all successfully. Two of them were in the initial stage, while a few showed advanced signs of softened tissues. No relapses have occurred so far.—*Comptes Rendus,* Feb. 26; abstracted in Lond. *Elec.,* March 16.

Electricity in Medical Practice.—JONES.—An abstract of the discussion which followed his paper, noticed in the Digest March 31. Mr. Mordey suggested the use of thermopiles for charging small cells, which could easily be produced for such a purpose. He further called attention to the fact that the design of the Rhumkorff coil and other electrical apparatus actually in use for medical purposes is very bad and could easily be improved.—Lond. *Elec.,* March 16.

United States and Great Britain.—HOPKINSON.—A long abstract of his presidential address to the Manchester Branch of the British Institution of Electrical Engineers, a great part of which dealt with the conditions of electrical engineering in the United States and Great Britain. Given a particular piece of work, done in a particular way, and with given appliances, he has never seen any evidence to prove that the work is done more cheaply in America. The American workman has higher wages, and probably accomplishes somewhat more in a given time, so that the net result is probably the same. That the output of the American workman is somewhat greater is partly due to mere physical causes, such as better ventilated and lighted workshops, etc.; partly to the greater stress which characterizes American life generally, but chiefly to the fact that American workmen are in general much better educated than English workmen, not in the sense of mere technical knowledge of their work, but they are generally more cultured and have a wider mental horizon. American electrical industry is much more concentrated into comparatively few shops on a larger scale, than most of our English shops; there has been greater possibility of standardization in every detail, and repetition of types, and consequent inducement to the introduction of automatic machine tools.—In an editorial article of Lond. *Elec. Rev.* it is said that while the American workman accomplishes somewhat more in a given time and is in receipt of higher wages, the net result is not the same, for it follows at once that capital charges bear a smaller proportion to the total cost of production. The conditions in a factory are analogous to those in an electric plant in this respect; the higher the load factor of the plant, the less are the fixed charges in proportion to the total. The greater refinement of the American workmen is questioned.—Lond. *Elec. Rev.,* March 9; Lond. *Elec.,* March 16. A reprint of the full address in Lond. *Elec. Eng.,* March 9, 16.

Philippine Islands.—An article stating that during the last two months there has been a great demand for electrical apparatus of all descriptions in the cities and towns of the Philippines. In every town there are a certain number of rich natives who would gladly invest their money for a small return. The present machines shops are very inferior, all machinery and tools must be imported. The native metal workers at present use no system whatever. Native machinists work for 25 to 35 cents per day, American money, in the morning from 6 to 11, and in the afternoon from 2 to 6. Buildings for power stations can be erected at a comparatively very low cost. There are practically no developed water powers yet in service, but fuel can be secured in abundance from the immense forests. The chief demand at present is for electric railroads for connecting all important centres; also for electric devices and light installations.—*West. Elec.,* March 24.

REFERENCES.

Alternating Currents for Medical Purposes.—An illustrated description of an application of alternating currents of high frequency and high voltage for curing rheumatic and nervous diseases. The patient stands in a cell surrounded by a coil to which such currents are supplied that he is exposed to the alternating magnetic field.—*Elek. Anz.,* Feb. 15.

X-Ray Burns.—HOPKINS.—A discussion of the cause of this phenomenon; he offers an explanation and enumerates the explanations offered by others. He prefers to call the effect "white gangrene," and recommends the use of static machines driven by hand.—*Phila. Med. Jour.,* January; abstracted in *Hahnemanian Mo.,* February.

Electric Heating.—LAFFARGUE.—An illustrated description of some French electric heating apparatus.—*La Nature,* Feb. 24.

Switzerland.—An illustrated article on some new electric plants in Switzerland which were already referred to in the Digest. In 1899 the imports of machinery into Switzerland amounted to more than $1,400,000, chiefly from Germany. American manufacturers should avail themselves of the opportunity offered there.—*West. Elec.,* March 24.

India Rubber.—A note on the cultivation of india rubber trees in Mexico and Central America.—*App. Pop. Sc. Mo.,* April.

Electrical Laboratory.—An illustrated description of the electrical laboratory of the Armour Institute of Technology at Chicago.—*West. Elec.,* March 24.

Engineering Education.—BORROWMAN.—The first part of a long abstract of a paper on some considerations affecting the training of young engineers.—Lond. *Elec. Rev.,* March 16.

Biographical.—An account of the life and work of the recently deceased electrochemical engineer, Emile M. H. Andreoli.—Lond. *Elec. Rev.,* March 9; *Eng. and Min. Jour.,* March 24.

Electrical Engineers in the War.—An account of the speeches held at the "send off" dinner of the British electrical volunteer engineers who were to leave for South Africa.—Lord Kelvin presided.—Lond. *Elec. Rev., Elec. Eng.,* March 9; *Lightning,* March 8.

New Books.

A TRAVERS L'ELECTRICITE. Par Georges Dary. Paris: Librairie Nony & Cie. 429 pages, 8¼ ins. by 12¼ ins., 345 illustrations.

This interesting and imposing volume is designed by the author, a well-known writer on popular electrical subjects, to make the general reader familiar with the marvelous rather than the engineering side of electrical science, and is, therefore, not encumbered by technical details that are intelligible and interesting only to the trained electrician.

LIBRARY, UNIVERSITY OF MICHIGAN

The twenty chapters into which the book is divided deal with the numerous applications of electricity to the arts, sciences and industries, the first chapter being devoted to an exposition of the theory of electricity. In the appendix a description of the electrical installations proposed for the Paris Exposition of 1900 is given. The volume is printed in handsome type on heavy paper and contains an abundance of illustrations, a number of these being more or less well-drawn portraits of men eminent in electrical science. The engraving intended to represent Ampère bears no semblance to the authentic portraits of that savant; it appears to be a reproduction of a print frequently met with in popular electrical books, and which either originated in an artist's imagination or was mistakenly drawn from the portrait of some other man. The Americans whose likenesses we find reproduced are A. Graham Bell and Thomas A. Edison.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Published by the Institute. Vol. XV. 1898. 812 pages, numerous illustrations. Price, $5.00.

The fifteenth volume of the *Transactions* of the American Institute of Electrical Engineers contains 754 pages on which are recorded the proceedings of ten regular meetings, and there is appended a 68-page catalogue of members. The frontispiece consists of an excellent portrait of the Institute's twelfth president, Mr. A. E. Kennelly.

Of the various papers four are devoted to dynamos and motors, three relate to alternating current machinery, three are on electrical theory, three on railways, two on central stations, two on lighting and light distribution, two on telephony, two on transformers, two on education, two on standardization and one each on batteries, transmission of power and measurements. Seventy members out of a total membership of 1133 took part in the discussions.

A valuable feature consists in the topical discussions which the society has recently inaugurated. This refers in particular to the discussion of "The Standardization of Generators, Motors and Transformers," participated in by twenty-three members, or over one-third of all the members taking part in discussions during the entire year. Perhaps the most valuable paper presented during the year is that on "High Voltage Transmission," by Chas. F. Scott, a résumé of this important subject brought up to date.

The concluding pages of this interesting volume sadly remind us of the fact that the great harvester is busily at work among the ranks of pioneer workers in the electrical field, whose places are difficult to fill and whose life work will be their lasting monuments. This roll of honor contains the names of Emery, Shallenberger, Perry, Varley, Gott and Smith, the first two being most eloquently eulogized.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

CHICAGO ELECTRICAL ASSOCIATION. Next meeting, April 6. Paper: "Transformer Design," by Prof. Irwin J. Macomber.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Ottawa, Ont., June 27, 28 and 29, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Next meeting, Chicago, May 22, 23 and 24, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Detroit, Mich., June 20, 1900.

SOUTHWESTERN GAS, ELECTRIC & STREET RAILWAY ASSSOCIATION. Next meeting, Waco, Texas, April 12, 13 and 14, 1900.

Wiremen's Calculating Gauge.

By means of the calculating gauge shown in the accompanying illustrations, a wireman when at work can instantly decide what is the proper size of wire for him to use in any particular job. The operation of the gauge is extremely simple, and does not require a knowledge of its principles of construction in order to understand its use. It is merely necessary to know the number of feet from the initial point or centre of distribution, the amperes and the voltage in order to apply the gauge. The number of feet on the small circle is set opposite the number of amperes on the large circle, and then the small pointer is brought opposite the voltage of the dynamo and

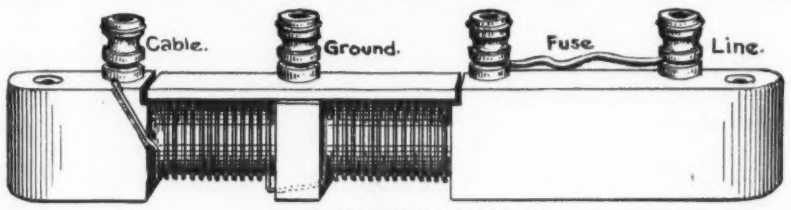
FIGS. 1 AND 2.—WIREMEN'S CALCULATING GAUGE.

the given percentage of loss. The gauge is then turned over and the large pointer indicates the size of wire which should be used, and also indicates the safe carrying capacity of this wire in amperes. In addition the slot *A* forms a gauge by means of which the wire can be accurately measured. The illustrations show the gauge set for 45 amperes, 60 feet, 110 volts and 1 per cent. loss, the wire indicated being No. 3.

The tool is handsomely finished in polished steel and so accurately formed that the parts move smoothly, and yet the indications are given with great precision. The gauge is arranged for all distances from 20 to 400 feet and for amperes from 1 to 128. The voltages provided for are 55 at 2 per cent.; 110 at 1 per cent. and 2 per cent., and 220 at 1 per cent. drop. By a very simple calculation the gauge can be used, if necessary, for any other voltage or percentage of loss. The useful tool described is made by the United States Electrical Supply Company, 145 East Twenty-fifth Street, New York.

The Argus Lightning Arrester.

The lightning arrester illustrated herewith is a departure from the old pattern of devices of this character, both in design and principle of operation. It consists of a porcelain base having two grooved sections around which a bare aluminum wire is wound spirally, and a ground plate adjacent to the entire length of the coil and separated from it by an air space. The aluminum wire has a resistance of about one-fortieth of an ohm. The coil is designed to act as a choke coil, and cause the lightning to jump from the spiral line wire to the ground plate. The main idea of the coil is that it not only acts to choke the direct passage of the lightning, but at the same time it disrupts the discharge so that it reaches



LIGHTNING ARRESTER.

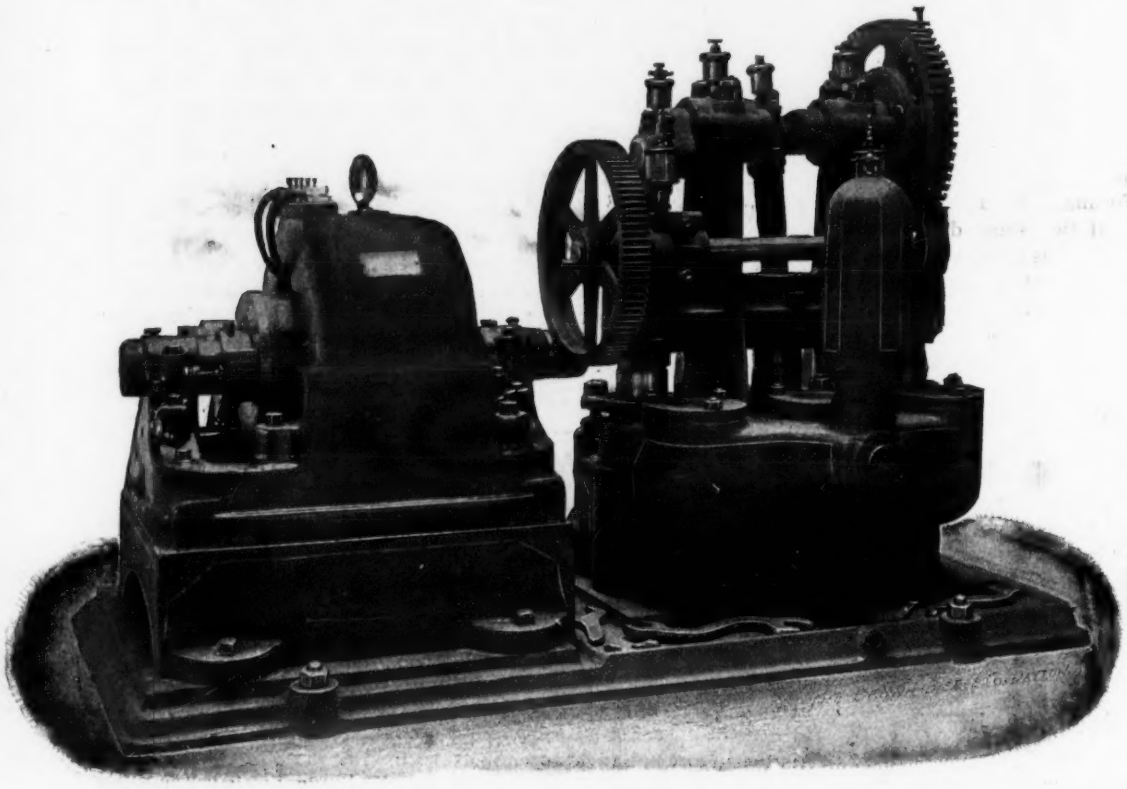
the ground plate in the form of numerous smaller discharges from the various convolutions of the coil, thus preventing the discharge at any one point being heavy enough to melt or raise a burr on the ground plate. This arrester is made in three different types, and is claimed to be thoroughly practical, both in efficiency and design. It is fire-proof and does not accumulate dust or dirt.

The Argus arrester appeals especially to those who are interested in the telegraph, telephone and railroad signal fields. It is made by Foote, Pierson & Co., 82 Fulton Street, New York City.

Direct-Connected Triplex Pump for Siam.

Electric power is being extensively employed in operating pumping machinery, not only for mines, municipal water supply, office and hotel buildings, general manufacturing plants, hydraulic elevators, condensers, house supply, but also for boiler-feeding purposes. The three-throw type of triplex pump is receiving consideration for the reason that it is asserted that the continuous discharge resulting from this type of pump and the consequent decreased vibration throughout the delivery system are more advantageous for the motor than types heretofore used. Owing doubtless to these advantages, Mr. G. W. Dickie, designer of the battleship Oregon, recommended in a paper read for the 1899 annual meeting of the Society of Naval Architects and Marine Engineers, the use of electrically-driven triplex pumps for ship drainage purposes.

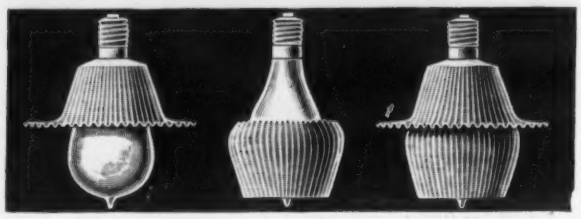
The accompanying illustration shows an electric triplex pump recently exported to Siam by the Stilwell-Bierce & Smith-Vaile Company, of Dayton, O. A common base is provided for both pump and motor, which insures absolute alignment, and renders expensive foundations unnecessary, at the same time giving compactness and solidity. The motor shaft is extended and there is mounted thereon either a rawhide, bronze or iron pinion, engaging spur gear on the motor shaft. The necessary reduction between the speed of the motor and the speed of the main crank is thus accomplished. Instances where a special low-speed motor is employed, single reduction of gears can be had. This machine is a Smith-Vaile outside packed and outside guided triplex pump. The side thrust of the connecting rods, which has heretofore proven an objectionable feature of triplex pumps, is now accommodated at the cross-head, and is not communicated to the glands. All gears are machine cut. The operation of the pump is said to be practically noiseless.



ELECTRIC TRIPLEX PUMP.

McCreary Rainbow Shades.

The illustrations herewith show three styles of paper shades for the temporary decoration of incandescent lamps for parties, weddings, suppers, banquets, balls and all other kinds of public and private entertainment. The shades are made in four colors—red, blue, pink and yellow—and can be instantly adjusted or removed. All parts are interchangeable, so that a great variety of decorations may be obtained. The style of shade shown in the first illustration is designed for the upper part of the lamp only; that in the second illustration is for the lower part of the lamp, and the third shade covers the entire lamp. These shades are made by the A. A. McCreary Company, 136 Liberty Street, New York, of French paper which does not injure or discolor the lamp globe.



APPLICATION OF RAINBOW SHADES.

A Bench Drill.

A new drill designed for all classes of light drilling has been placed upon the market by Mr. George Burnham of Worcester, Mass. This machine, of which an illustration is shown herewith, has two changes of speed, and is warranted to do perfectly true work. The principal dimensions are as follows:

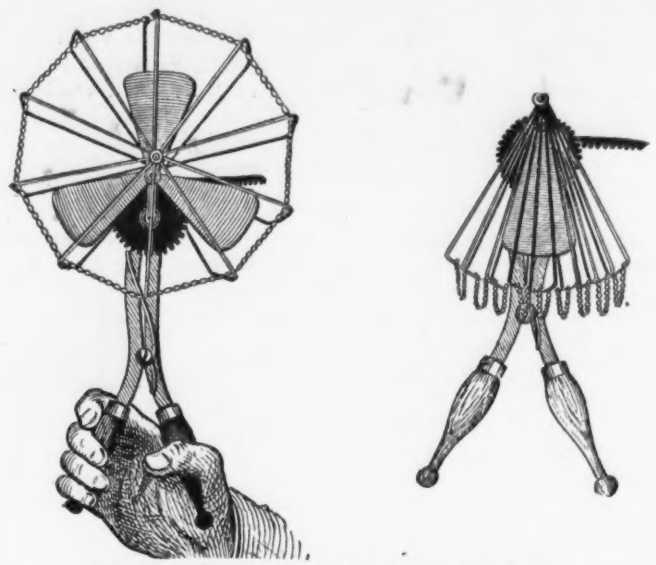
Run of ¼-inch spindle, 2⅝ inches; size of swinging table, 6½ inches; adjustment of the same, 8 inches; greatest distance from lower table to chuck, 12 inches; height over all, 26 inches. The drill occupies a space 7x18 inches, and will drill to the centre of a 7¼-inch circle. Though weighing but 55 pounds, the machine will drill up to ⅜-inch holes.

BENCH DRILL FOR LIGHT WORK.

Auto-Rotary Hand Fan.

A decided novelty in the fan line is shown in the accompanying illustration, which represents a rotary fan actuated by the pressure of the hand. Among the principal advantages of this device is that it can be carried around and is not dependent upon any outside source of power supply. One pressure of the hand rotates the blades for several minutes, the speed reaching a maximum of 2800 revolutions per minute. The guards, as well as the blades, may be

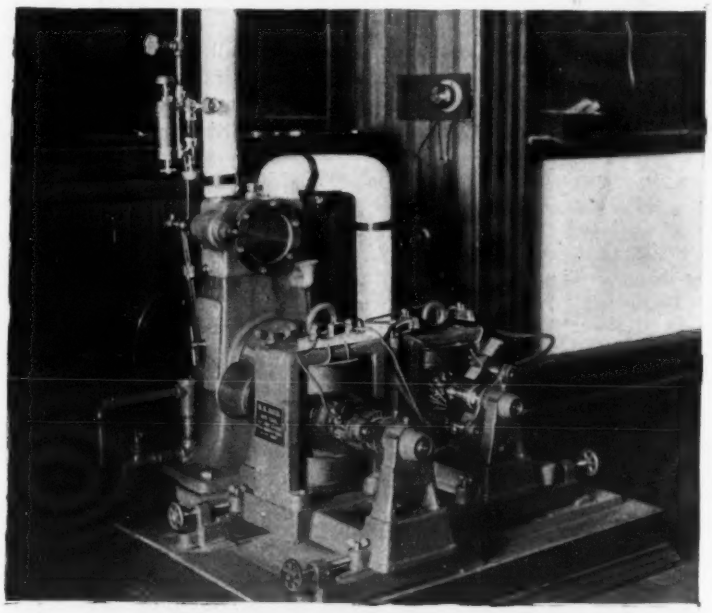
folded up, as shown in one of the illustrations, and the fan may then be carried in the pocket. It weighs less than five ounces and is finished in heavy nickel plate. Its operation as shown in the illustration is on the rack and pinion principle, the reciprocating motion being obtained by means of the tongs which are held in the hand in the manner shown. This unique device is manufactured by Vincent Gray, 330 Carondelet Street, New Orleans, La.



FIGS. 1 AND 2.—HAND FAN OPEN AND CLOSED.

A Compact Double Generating Set.

The accompanying illustration shows a double generating set made by the Maxwell M. Mayer Company, 2369 Second Avenue, New York, for St. John's College, at Fordham, N. Y. It consists of a Case engine actuating one or both of two small dynamos by means of friction pulleys. One of the machines is a 1½-kw, 110-volt dynamo, which will be principally used for operating a stereopticon lamp; the other is a 10-volt dynamo which will furnish current for a Röntgen ray coil and for various experimental purposes. The engine runs at 800 r. p. m. and the dynamos at double that speed. The pulleys on the dynamos are leather covered and engage directly with a pulley on the shaft of the engine. Adjustments may be made such that the engine will run either of the dynamos separately or both at the same time.



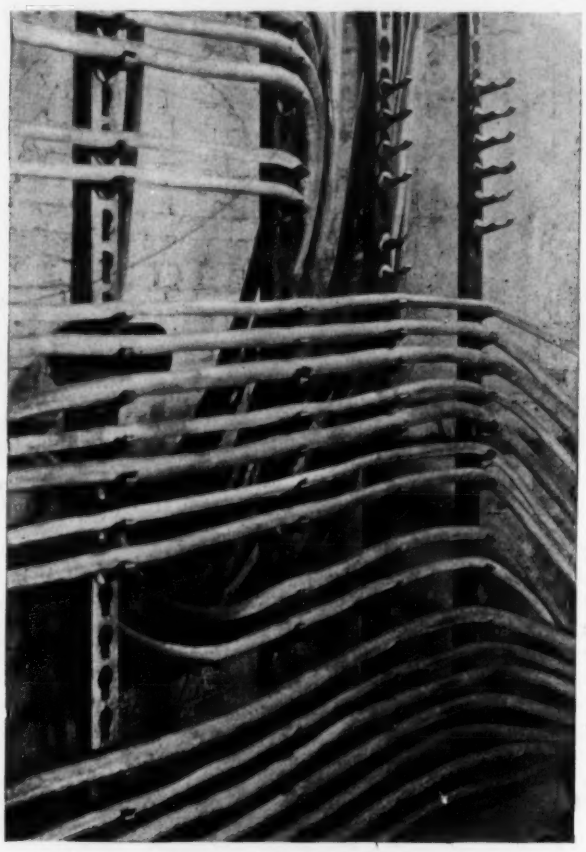
DOUBLE GENERATING SET.

The set is installed in a classroom, and in order to avoid noise and vibration the following arrangement was made: The common base consists of a wooden frame filled with cement. On this is a sheet of heavy rubber and the bases of the several machines rest directly on the latter. The noise and vibration in the classroom when the set is in operation is so small as to be entirely negligible.

Cable Hanger.

A new form of cable hanger for use in manholes and underground cable vaults is shown in the accompanying illustration in one of its applications. It consists, essentially, of a channel iron upright which is bolted against the wall of the manhole. Throughout the length of the channels holes are punched, the shape being somewhat that of a key hole. The hangers are made with a button on the back so that a hanger can be placed at any desired point on the channel by simply inserting the button through the hole; the hanger is held securely in its place by its own weight and the weight of the cable which is hung on it. The hanger shown in the figure is made for one cable, but they are also made for two, three or four cables. A bracket which is designed to hold junction boxes may also be secured in a similar manner to the hangers.

The manufacturers claim a number of advantages for this system



CABLE HANGERS IN USE.

of hanging cables. In the first place, the entire structure is of metal, so that it is of the most durable nature. The hangers being designed especially for cables, all sharp edges have been eliminated, and the hangers will turn in their position so as to assume any angle corresponding to the bend in the cables which it supports, thereby preventing the burn-outs caused by the use of pipe-straps, pipe-hangers, etc. The construction is substantial, and by using it a manhole containing a number of cables can be called a "mechanical job," which term does not apply to many of the manholes throughout the country.

It is evident that time can be saved when cables are being spliced if the splicer can place a hanger at any point on the wall of his manhole, to hold the cable he is working on in position. Junction boxes can be placed on the wall of the manhole where they are out of the way, and at the same time leave plenty of room for the cables. For shallow manholes, multiple hangers may be used, thus providing room for many more cables than can ordinarily be disposed of.

Manholes are equipped with channels having a number of holes corresponding to the number of ducts entering the manhole, so that when a cable is drawn into a duct it is necessary only to place a hanger in the corresponding hole in the channel. The manu-

facturers, Macferran & Heywood, Thirteenth and Mt. Vernon Streets, Philadelphia, have equipped several hundred manholes in Philadelphia, New York and Milwaukee with these hangers.

Sprague Electric Company at Paris.

The Sprague Electric Company has sent to the Paris Exposition a handsome display of interior conduits and appliances. The illustration shown on this page gives some idea of its appearance, but,

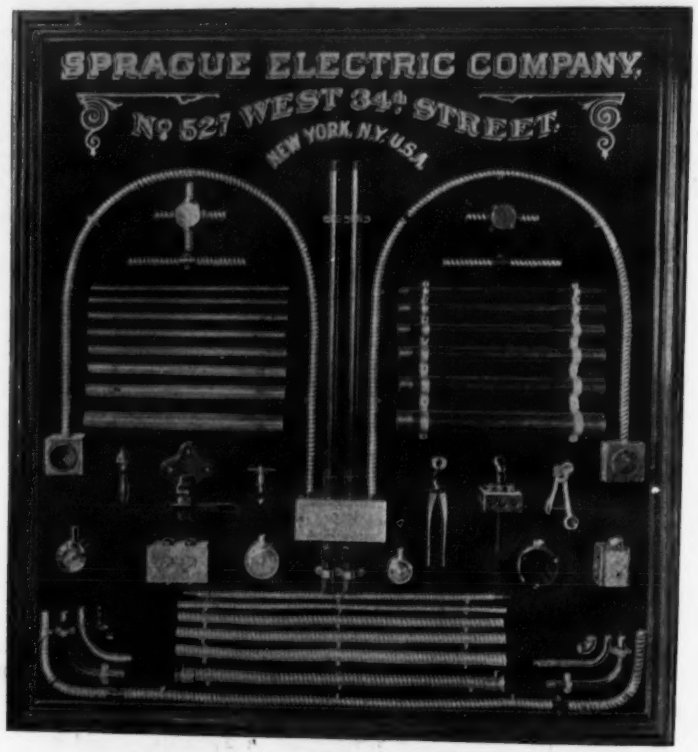
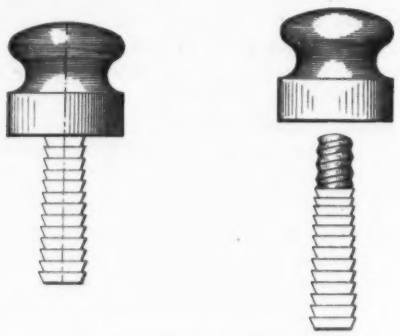


EXHIBIT OF INTERIOR CONDUIT AND APPLIANCES.

of course, a photographic reproduction fails to bring out the color and general harmony. The board is 6 feet wide and 8 feet high. It illustrates the application of the Greenfield flexible steel conduit and universal junction boxes, together with some samples of armored cable and brass-armored and iron-armored insulating conduits. The Lundell apparatus, while not specially exhibited, will be shown to good advantage, as many exhibitors have selected it for the operation of their machinery. The United States government also has purchased a large number of Lundell fans for use in the Government exhibition building.

New Type of Wall Insulator Pin.

The accompanying illustrations show a new type of wall insulator pin. A stem of any non-oxidizable metal or alloy of metals



WALL INSULATOR.

is provided with an ordinary screw-thread at one end for an insulator, and the main body of the stem is formed with angular grooves. This portion is put in a hole pierced in a wall and secured therein with cement or any other suitable material, the screw-threaded portion, of course, projecting. As this latter portion is adapted to engage with an inside screw-thread of an insulator, the latter is simply screwed upon the threaded portion.

As the insulator is thus put up without the use of a special screw, there is not only saved the usual iron screw, which oxidizes and thereby affects the insulator, but also considerable time; moreover, the stem once fastened in the wall, it is perfectly secure against loosening. The inventor is Dr. Alfred Muller, 132 Nassau Street, New York.

Hoods and Poletops for Enclosed Arc Lamps,

The practically weatherproof features of the modern enclosed arc lamps make it unnecessary to use the large protecting hood which was so essential with the open arc lamps. All that is needed now is a hood fitted with an insulating hook for supporting the lamp, the hood itself being just large enough to cover the exposed terminals and the ventilating openings at the top of the lamp. Such a hood is now offered by the George Cutter Company, of Chicago, the suspension form being fitted with the same "strong arm" described in our issue of Jan. 20 last. The poletop is stated to be equally simple and strong,

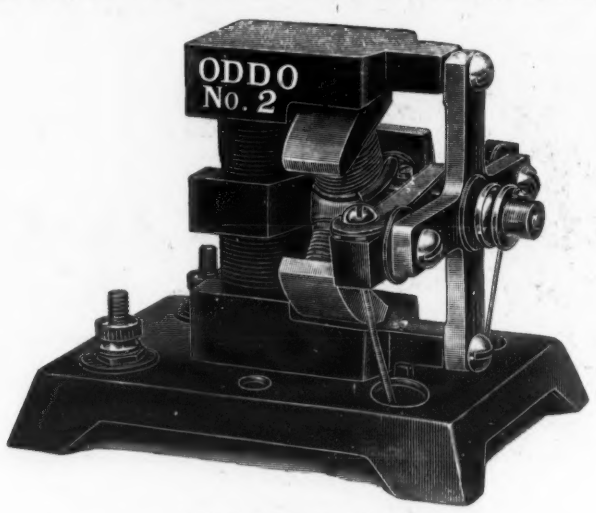
FIG. 1.—HOOD FOR ENCLOSED ARC LAMP.

FIG. 2.—POLETOP FOR ENCLOSED ARC LAMP.

and as it has no projecting base it will not cast a heavy shadow at the base of the pole.

Small Electric Motor.

The accompanying illustration shows a small electric motor intended for use with fans, for driving mechanical toys, model machines, advertising devices, window displays, mechanisms, etc. As will be seen, the armature is of the modified Siemens shuttle type,



SMALL ELECTRIC MOTOR.

which admits, it is claimed, of a greater leverage than the original type. The height of the machine is 3⅛ inches and its weight 20 ounces. The motors may be driven from a single cell of battery The above motor, known as the "Oddo," is made by the American Oddity Company, 170 Broadway, New York.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Speculation on the stock market was active and strong, but, notwithstanding the increasing demand for loans on this account, the money market showed an easier tone. An expanding speculation is reflected in the bank clearings returns, which aggregate $1,731,000,000, an increase of 8 per cent. over those of the previous week, most of which, however, is chargeable to New York, as outside of that city the clearings show a gain of a fraction of 1 per cent. The gross railway earnings of 64 roads for the third week of March are reported to Bradstreet's as $8,756,508, a gain of 10 per cent. over the same week a year ago. The majority of stocks closed at prices higher than the closing prices of the week previous. Among the most important net advances were Brooklyn Rapid Transit, 5½; Metropolitan Street Railway, 4¾, and American Steel & Wire and Manhattan Railway, 1⅞ each. The traction stocks advanced on a belief that franchise assessments under the Ford law in New York would not be excessive, and held steady even after the announcement of considerable increases in their valuations made by the commissioners. In the electrical list the following transactions are recorded for the week: 335 shares of American Telegraph & Cable were sold at 91; Brooklyn Rapid Transit fluctuated between 68 and 74, the closing price being 72⅞. The number of shares sold was 156,612. General Electric was quiet, the sales amounting to 3810 shares. This stock ranged from 128¼ to 131¼, the former figure being the closing price, as well as the lowest. The net result of the week's transactions was a loss of 1¼. Metropolitan Street Railway sold as high as 167, the lowest figure recorded being 159. It closed at 165. The sales were 48,171 shares. Third Avenue Railroad kept above par all the week, going as high as 105¾; the lowest point reached was 101. It closed at 105. The transactions were 11,790 shares and the net result was a gain of 1½ per cent. Western Union was dull, the sales amounting to only 2831 shares. The stock closed at 84⅛, representing a net gain of ⅛. Trading in outside securities did not continue as active as it was on the first few days of the present upward movement, but nevertheless it was in fairly large amount compared with the records of a few weeks ago. Among the electric stocks were some that were quoted considerably lower, and in other groups as well declines were noted, but all told, the market can well be said to have shown satisfactory strength and to have given much promise for further improvement in the near future. Electric Vehicle was notably strong early in the week, and sold at an advance of about 10 points over the previous week's closing bid. On Saturday, however, it reacted several points, showing at the close a net gain of only 2 points, the final bid being 40. New York Transportation was in smaller demand and declined fractionally. New England and Illinois Transportation were quiet and showed practically no change. Electro Pneumatic was one of the features on the curb during the week and on large orders to buy the stock advanced ½ point to 1½. It is rumored that the company will benefit by the underground tunnel. The closing prices in the Boston market were: American Bell Telephone, 310; General Electric, preferred, 136; Mexican Telegraph, 2⅝; Westinghouse, 45 asked; Westinghouse, preferred, 61. In Philadelphia, Electric Storage Battery closed at 90 bid, 95 asked; Electric Storage Battery, preferred, 95 bid, 97 asked; Philadelphia Traction, 96⅝.

THE PHILADELPHIA ELECTRIC COMPANY.—As our readers have doubtless gathered from the items appearing from time to time in these pages, the control of the electric lighting business of Philadelphia has recently been undergoing a gradual but radical transformation. The company at present controlling the various lighting companies is the Philadelphia Electric Company. This company is composed of two other companies, the Pennsylvania Manufacturing, Light & Power Company and the National Electric Company, which in turn control the following companies: The Pennsylvania Manufacturing, Light & Power Company controls the Edison Electric Light Company, Brush Electric Light Company, Northern Electric Light & Power Company, Powelton Electric Company, Diamond Electric Company, Suburban Electric Company, Manufacturers' Electric Company, Wissahickon Electric Light Company, Germantown Electric Light Company, Columbia Electric Light Company, West End Electric Company, Bala & Merion Electric Company. The National Electric Company controls the following: The Southern Electric Light & Power Company, Beacon Electric Company, Cheltenham Electric Light, Heat & Power Company, Overbrook Electric Company. The capital stock of the Philadelphia Electric Company is $25,000,000, divided into 1,000,000 shares, par value $25, on which $2.50 or 10 per cent. is paid in. Their stock closed on March 29 at a quotation of 5¼. The officers of the concern are as follows: President, Jos. B. McCall; vice-president, William F. Harrity; secretary, A. V. R. Coe; treasurer, William P. Conover, Jr.; directors, Jos. B. McCall, William F. Harrity, A. V. R. Coe, W. L. Elkins, P. A. B. Widener, Thomas Dolan, John M. Mack, J. J. Sullivan and Dr. J. V. Shoemaker.

GENERAL ELECTRIC STATEMENT.—The General Electric Company has filed within the past few days a certificate of condition with the Commissioners of Corporations of Massachusetts. A Boston financial paper gives a summary of the report as follows: Assets: Real estate, $621,840; cash and debts receivable, $10,082,425; merchandise, $6,629,819; patent rights, $4,000,000; miscellaneous, $10,366,635; total, $31,700,719. Liabilities: Capital stock, $20,872,200; debts, $7,104,205; profit and loss, $3,769,314; total, $31,700,719. A report of like nature filed by the Thomson-Houston Electric Company, of Connecticut, doing business in Lynn, Mass., shows its financial condition on March 1 as follows: Assets: Real estate, $588,701; machinery, $437,298; cash and debts receivable, $14,757,570; merchandise, $1,116,476; patent rights, $1,500,000. Liabilities: Capital stock, $10,000,000; profit and loss, $8,420,046; total, $18,420,046.

DIVIDENDS.—The New York & New Jersey Telephone Company has declared a quarterly dividend of 1½ per cent., payable April 14. The New England Telephone & Telegraph Company has declared a dividend of $1.50 per share, payable May 15. The Mexican Telegraph Company has declared a quarterly dividend of 2½ per cent., payable April 16. The Wisconsin Telephone Company has declared a dividend of 1¾ per cent., payable April 9. The Cincinnati Edison Electric Company paid a dividend of 1¼ per cent. on its common stock on April 2. This is said to be the first dividend paid by this company.

THE NIAGARA FALLS POWER COMPANY, of Buffalo, N. Y., on March 30 filed a certificate of an increase of capital stock from $3,500,000 to $6,500,000, the increase to consist of 30,000 shares. Up to and including April 1, 1905, the 30,000 shares are to be issued only at par, and in conversion at par for 6 per cent. coupon gold debentures of the company. The certificate states that the amount of capital stock of the company actually paid in is $3,331,000, and that its debts and liabilities consist of $9,629,000 first mortgage bonds and other indebtedness of $30,000.

ADDITIONAL SECURITIES LISTED.—Among the securities listed at the New York Stock Exchange last week were $3,333,300 additional issue of the Commercial Cable Company's stock, making the total amount listed $13,333,300, and Metropolitan Westside Elevated Railway Company's first mortgage 4 per cent. 40-year gold bonds, $10,000,000; 5 per cent. non-cumulative preferred stock, $9,000,000.

ELECTRIC DEAL IN SEATTLE.—A Chicago despatch states that the combination of Seattle electric, traction, light and power companies has been closed. The capital stock is $6,200,000. Bonds to the extent of $5,000,000 will be authorized, of which $3,500,000 will be issued, bearing 5 per cent. and running 30 years.

GENERAL ELECTRIC ANNUAL MEETING.—The annual meeting of the stockholders of the General Electric Company will be held at Schenectady, N. Y., on Tuesday, May 8. The transfer books will be closed at 12 o'clock, April 14, and reopened at 10 a. m. May 9.

THE ELECTRIC COMPANY.—A Philadelphia despatch states that expert accountants are to go over the books and verify the statements of the numerous companies owned by the Electric Company of America.

Commercial Intelligence

THE WEEK IN TRADE.—Generally favorable trade conditions prevail, though dulness is noted here and there. It was a quiet week in the distributive trade. Little that is new is observable in the iron and steel trade. The strength of values generally is most marked at the west, where the only weak spot is claimed to be in plates. Advances in wages of bituminous coal miners remove any

possible source of weakness as regards the fuel situation. Anthracite coal is dull and seasonably weak, with rumors of export business to Russia being negotiated. A New Orleans despatch states that an English syndicate of coal dealers has closed a deal by which 2,000,000 tons of Alabama coal will be exported from New Orleans during the next two years. Alabama coal has recently been sold in large quantities in the West Indies and on the Gulf of Mexico and Caribbean Sea, displacing considerable English coal sold there; but this is the first time it has ever been proposed to send it to England. The strike at Chicago, Bradstreet's says, hurts the lumber and building material trade, but the passing of the first quarter of the year without any weakening of iron and steel prices is regarded as encouraging. Business failures for the week, as reported by Bradstreet's, number 178, as compared with 192 last week, 190 in this week a year ago, 226 in 1898, 212 in 1897 and 236 in 1896. According to Dun's report, iron is growing weaker, except in Bessemer pig, which is held at $24.90 in Pittsburg, in spite of small sales of eastern at lower figures. Anthracite No. 1 has sold little above $23, and basic at $22.50, with eastern forge offered at $20.50 at Pittsburg. In finished products a change appears in refined bars, which sell in large orders close to 2c at Philadelphia. Better prices are expected from the consolidation in sheets. The market for copper during the week was firm, with an excellent demand. No Lake quotation can be obtained lower than 17 cents. Electrolytic copper was quoted at $16.60 to 16¾ cents, and casting stock 16½ cents. Exports from this country continue at an enormous rate and supplies are greatly depleted. A number of important producers are reported to have sold all their product available for the next few months. *The Iron Age* says that the iron market is disappointingly quiet and that new business is not developing as it should at this season of the year. The situation, it says, is commonly regarded as a deadlock between buyers and sellers, but this is more apparent than real.

MEXICAN ELECTRIC RAILWAY CONTRACT.—The business of the Tranvias Electricos del Distrit Federal de Mexico—the local designation for the electric road in the City of Mexico—though only put in operation last month, has assumed such proportions as to warrant a considerable extension of the line. It will be recalled that A. E. Wodswick, the chief engineer and general manager of the road, recently paid a visit to the United States for the purpose of placing contracts for the initial equipment of the road. Private parties who have seen the advance specifications state that everything in the way of material and equipment will be purchased in America. The road is financed through the London financial house of Wernher, Beit & Co., whose Mr. Alfred Beit was the discoverer of the famous De Beers diamond mines in South Africa. The London firm is also interested in the Lisbon tramways, as well as several roads operating in South Africa. It is said that the power house, which was built by the Riter-Conley Manufacturing Company, of Pittsburg, will be added to and that preference will be given, according to the usual English custom, to the bids which emanate from the suppliers of the material and equipment for the original road. Though it is not yet decided to what exact distance the road will be ultimately extended, the specifications, as they now stand, call for an expenditure in the neighborhood of $150,000.

COAL FAMINE IN EUROPE.—The inability of England to supply her neighbors with their usual quota of coal is causing a coal famine in Germany and other industrial countries on the continent. To supply this deficiency American coals are being burned in place of English, and there is an urgent demand for this fuel, which America alone seems to be in the position to supply. The effects of the coal famine in Germany is evident by the fact that about 1,000,000 men, so reported, are out of work because of the lack of fuel and raw stuffs. Consul Skinner, of Marseilles, reports that 60,000 tons of Pocahontas coal are now coming through Gibraltar, where none came before, and that coal is selling at any price in the French cities. The firm of Worms & Co., of Marseilles, expect that their imports of American coal will become regular and on a large scale. Considerable shipments of American coal are being made to the West Indies, South America, Las Palmas, Genoa, etc. It is reported that the Baltimore & Ohio, Norfolk & Western, Pennsylvania and Chesapeake & Ohio roads are making every preparation to meet this new export demand. Independent coal miners are looking for new properties, as the general belief prevails that when Europe begins to buy American coal there will be a continuous demand which will increase in coming years. Elsewhere in this issue is given a fuller account of the coal situation in Germany and France

AMERICAN MACHINERY FOR JAPAN.—A company with a capital of 500,000 yen (about $250,000) has been organized in Kyoto, Japan, to build an up-to-date lithographic, printing and paper box manufacturing plant, to be operated by electrical power. Among those interested are F. A. Stecher, of Rochester, N. Y. All the material for the plant, with the exception of the bricks and mortar, will be purchased in the United States. The Sprague Electric Company, of New York, has secured the order for the electrical apparatus. The printing presses will be driven by direct-connected motors. Eighteen motors, ranging from ¼ to 16-hp, have already been ordered, and it is said that $15,000 in all will be expended in this direction. The Franklin Machine Works, of Philadelphia, have also been awarded a contract for machinery in connection with the box-making apparatus. A number of these orders will, it is believed, be given out in a few days. Several Japanese have been undergoing a course of lithographic instruction at Rochester, N. Y. H. A. Corkhill, of Rochester, has been appointed the chief mechanical engineer of the new works. He will sail shortly for Kyoto for the purpose of superintending the construction of the plant, which will be completed by July next. Mr. Corkhill will be accompanied by four skilled American mechanics.

SUPERIORITY OF AMERICAN MANUFACTURES.—United States Consul Boyle reports that recently a number of communications and articles have appeared in the Liverpool papers drawing attention to the fact that American manufactures, particularly in specialties, had been accepted by English purchasers in preference to those of home production, the reason given being that the American goods were better made and handier than the home goods and were fully as cheap. Of late, he says, there has been a tendency on the part of English critics to claim that American manufactures were preferred simply because they were cheap, and it was often added they were "nasty" as well as cheap. The statements referred to at the commencement of this report refute this criticism, and American manufactures can now find plenty of champions in England who base their support on the ground of actual superiority, both of workmanship and adaptability. This has just been significantly emphasized by the publication in semi-official form of a letter received by the Liverpool Chamber of Commerce from a well-known business man, in which it is stated that after careful inquiry and comparison the writer finds that German and American goods actually fetch better prices than English goods supplied for similar purposes.

ELECTRIC RAILWAYS IN TOKYO, JAPAN.—Information has been received to the effect that the Tokyo City Railway Company, of Tokyo, Japan, has obtained a concession from the Tokyo City Council to proceed with the construction of its proposed lines, which are to be some 200 miles in length. The capital of the company is stated to be 15,000,000 yen ($7,740,000), and it is to be spent in part as follows: For track material, including rails, etc., 3,525,000 yen; 600 electric cars, 2,140,000 yen; a 6000-hp power house, 1,500,000 yen; eight sub-stations are to cost 1,000,000 yen. For electric wire they are going to spend 2,000,000 yen. For stores and other buildings they have decided to spend 300,000 yen, and for bridges 1,000,000 yen. The workshops are to cost 250,000 yen; the ground, etc., 2,620,000 yen. The engineers propose to use 30 200-hp water-tube boilers, 5 1200-hp triple-expansion engines and 5 three-phase 3500-volt 800-kw dynamos, direct-connected. The rails to be used will be 60-pound of T-section. Many manufacturing firms have furnished estimates for the material wanted, but as yet no contracts have been placed, so far as known. The Tokyo City Railway Company can be addressed at Tokyo, Japan, or in care of the chief engineer of Public Works Bureau, at Tokyo.

SHAWINIGAN FALLS POWER PLANT.—A Canadian correspondent writes that it is authoritatively stated that the Westinghouse Electric & Manufacturing Company has received a contract for work in process of construction at Shawinigan Falls, in the Province of Quebec. The Pittsburg Reduction Company, of Niagara Falls, is building a plant there with a capacity of 5000-hp for the manufacture of aluminum, and has awarded to the Westinghouse Company a contract for four generators of 1250-hp each. The Shawinigan Water & Power Company has also contracted with the Westinghouse Company for two generators of 5000-hp each, to be used in the manufacture of electric power for its customers. Other contracts in connection with these industries will be let to the Westinghouse people later.

TRADE OPENINGS IN SOUTH AFRICA.—The war in South Africa will very naturally diminish the supply in that country of all articles of consumption and trade, and when it is brought to a conclusion there will be a large demand for goods to replenish the stocks and materials consumed and destroyed. Consul General Stowe at Cape Town calls attention to this important fact. Telegraphic and railroad equipment, vehicles, tools, etc., he says, will be needed, and the countless things required by a country emerging from a war will find a ready market. American manufacturers and producers therefore would do well to keep an eye on the South African Republics, and be in readiness to undertake an aggressive campaign in the more peaceful art of trade when the present strife of arms is terminated.

ARGENTINE TARIFF ON ELECTRICAL MATERIAL.—The following are the customs dues for machinery and electrical material imported into Argentine during the current year, as pub-

lished in the Monthly Bulletin of the Bureau of American Republics: Machinery in general, 10 per cent. ad valorem; iron or steel galvanized wire up to No. 14, 10 per cent.; wires or cables over 5 millimeters in diameter, for electrical purposes, and the necessary articles for the laying of submarine cables, 10 per cent.; plants for public electric lighting stations, 10 per cent.; automobiles, 10 per cent. Rails, tie-bars, wedges, chairs and all material necessary for electric traction purposes are admitted free of duty.

CHARLES WIRT & CO., of Philadelphia, have been incorporated under the laws of the State of Delaware as The Wirt Electric Co. The company is a close corporation, all stock being held by the three incorporators, Charles Wirt, Charles J. Cary and Irving B. Smith. The capital stock is $50,000. For nearly a year the old firm has been obliged to work overtime to fill orders, but with twice the available floor space and an increase in the force they hope to take care of all business that comes their way, promptly and satisfactorily. The lines of manufacture have been extended so as to completely cover the demands for rheostats, theatre dimmers, motor-speed regulators and special resistances. The manufacture of the well known Wirt dynamo brush will be continued. The offices and factory will remain at 1028 Filbert Street, Philadelphia.

ELECTRIC RAILWAY CARS FOR PARIS.—The Jackson & Sharp Company of Wilmington, Del., has secured a French contract for the supply of 125 double-deck trolley cars. The greater portion of the cars—all of which are to be of French pattern—will be utilized on the road now being completed between the American working machinery section at Vincennes and the collective exhibit to be installed at the Champs de Mars section of the Paris Exposition. The total length of the new line is to be seven miles. The balance of the cars are intended for various electric roads operating in the French capital and its immediate neighborhood. The contract is stated to be worth close on $300,000. The trucks are to be manufactured by the J. G. Brill Company, of Philadelphia.

ELECTRIC RAILWAY IN BUENOS AYRES.—Recently a franchise for a system of electric tramways was acquired from the Buenos Ayres municipality by Charles Bright, an American engineer. Within the past two weeks the Buenos Ayres Electric Tramways Company, Ltd., was organized in London to take over the concession. The capital stock has been fixed at £525,000, £58,330 in debentures, £58,330 in preferred shares, and the whole of the common shares are payable to the vendor upon transfer of the concession; for the balance the contractor undertakes to construct the tramway, to provide the company with a working capital of £22,000, and to equip the lines electrically within two years.

JAPANESE ENGINEERS.—Major General T. Ota, director of the Government arsenal at Osaka, Japan, accompanied by a number of skilled mechanical engineers, has been in Cincinnati about a week visiting the large machine tool-making concerns and manufacturers of machinery. In the party are G. Kuwada, H. Arita, C. Kabono and R. Hirota. The visitors represent their Government. They will visit Pittsburg and then Washington, D. C., before returning home. They say their visit will be productive of some large orders, and it is understood they left some good-sized ones with the larger wood-working machinery and machine tool manufacturers of Cincinnati.

INDUSTRIAL CORPORATIONS.—A summary of the industrial corporations of 1899, as published by the *Commercial and Financial Chronicle*, shows that the authorized capital of these various consolidations in 1899 aggregated $3,593,530,000, of which $2,354,305,000 was common stock, $912,275,000 preferred stock and $326,950,000 bonds. It is pointed out as significant that for the first half of 1899 the authorized capital of industrial incorporations aggregated $3,201,850,000, showing a very marked falling off for the last half of the year. The figures given include only those concerns having a capital of $1,000,000 or over, and does not include new railroad issues.

WEST END TRACTION COMPANY IMPROVEMENTS.—At a meeting of the board of directors of the West End Traction Company, of Pittsburg, held last week, it was decided to spend $75,000 immediately on improvements and betterments of the company's property. Two new 500-hp safety boilers will be added to the plant, making the total capacity 3000-hp. The company will also add ten new cars to its system, and plans are now being drawn for an entirely new building to take the place of the old power house, which is totally inadequate for the company's demands.

EXPORTS OF ELECTRICAL MACHINERY.—The "Monthly Summary of Commerce and Export" for January, 1900, compiled and published by the Bureau of Statistics, Treasury Department, shows exports of electrical machinery were as follows:

	1900.	1899.
January	$342,973	$303,702
Seven months ending January	691,838	428,728

WAGNER FOREIGN DEPARTMENT.—The Wagner Electric Manufacturing Company of St. Louis has established a foreign department, with headquarters in New York, of which Mr. Edward E. Goudey will have charge. Mr. Goudey will have offices in the Havemeyer building, in conjunction with Mr. A. H. Mustard, who will continue in charge of the regular New York branch of the Wagner Company.

TELEPHONY IN SPAIN.—A correspondent at Valencia, Spain, writes us that there is an excellent chance for an American capitalist to start a modern telephone exchange for the service of that city and adjacent port. The existing service, he says, is not only inadequate for the growth of the city, but absolutely no effort is made toward improvement in line with modern development.

STORAGE BATTERY EQUIPMENT FOR THIRD RAIL.—A large storage battery plant, it is reported, will be installed by the New York, New Haven & Hartford Railroad Company on its third-rail electric line between Hartford and Bristol, to furnish power for heavy loads. A special telephone service is also to be installed along the line.

ELECTRIC RAILWAY FOR VLADIVOSTOCK.—United States Consul R. T. Greener, at Vladivostock, Russia, telegraphs to the State Department that estimates for the construction there of an electric railway twenty miles long, electric lights and water works had been prepared and that proposals were desired from the United States.

CAR WORKS TO BE SOLD.—The car works of the John Stephenson Company, at Elizabethport, N. J., are to be sold at public auction on April 25 to satisfy the claims of creditors. The sale, which will take place at the works, will be conducted by the receiver, Mr. Albert A. Wilcox.

BIDS FOR STEAM AND ELECTRIC EQUIPMENT.—The Department of Correction of New York City is inviting sealed bids or estimates until April 12 for the installation of a complete high and low pressure steam plant, electric lighting, dynamos, elevator, etc., for the new city prison in Manhattan borough.

ELECTRIC COAL CUTTERS.—The C & C Electric Company recently closed a contract for 40 coal cutters. The same company has also sold to the Philadelphia *Call* a 35-hp special C & C press equipment. The C & C Company has also recently received several very large orders for its apparatus.

STANLEY ELECTRIC COMPANY.—It is stated that the Stanley Electric Manufacturing Company, of Pittsfield, Mass., advanced its prices on the 1st of March 10 per cent. The company within the past few days has received an order for 50 motors from an Illinois automobile manufacturer.

SPRINKLERS IN THE WESTINGHOUSE WORKS.—The Westinghouse Electric & Manufacturing Company is installing in its plant at East Pittsburg, Pa., an extensive automatic sprinkling system. This installation is said to be the most complete in the world and will cost $120,000.

ELECTRIC POWER IN STEEL WORKS.—In the proposed works of the Nickel Steel Company, of Hamilton, Ont., there will be two open-hearth buildings, about 800 feet long and 80 feet wide. Electric power will be used in the operation of the machinery in this plant.

THE STOW MANUFACTURING COMPANY, Binghamton, N. Y., reports the receipt of many inquiries regarding its portable electric drills from abroad, as well as from different parts of the United States. It is just shipping two of these drills to Russia.

GASOLINE ENGINES.—Messrs. Tuerk Bros. have made an application to the town of Berlin, Ont., for a site for a factory to manufacture gasoline engines and automobiles. It is their intention to erect three large buildings for that purpose.

MOTORS FOR ENGLISH NEWSPAPERS.—The Northern Engineering Company recently received an order for 19 electric motors to be used in driving printing presses in the plant of one of the large English newspapers.

AMERICAN COAL IN JAPAN.—The Japanese consul at Chicago reports that the steamer Needles has arrived in Japan with 6000 tons of coal from Virginia, the first coal ever received in Japan from the United States.

I. P. FRINK, 551 Pearl Street, New York, reports four important contracts for the installation of his patent reflecting fixtures for electric lighting in Paris, two of them being in connection with the Exposition.

COPPER STATISTICS.—European copper production (long tons) for February, 1900, aggregated 7241 tons, compared with 5868 tons the previous month, and 7399 tons February, 1899.

NEW PLANT FOR THE ELECTRIC LAUNCH COMPANY.—It is reported that the Electric Launch Company is preparing plans for a large plant in Bayonne, N. J.

Special Correspondence.

ENGLISH NOTES.

London Office of ELECTRICAL WORLD AND ENGINEER, March 17, 1900.

MUNICIPAL TELEPHONE ENTERPRISES.—Reference has been made in these columns to the fact that the corporations and local authorities of cities and towns in Great Britain were taking up telephone matters in addition to the varied business which they now conduct, and it seems very possible that Glasgow will be one of the first cities to be equipped with a telephone exchange operated by the corporation. The Glasgow corporation has leased for a period of 28 years the two upper stories of a new building, which will be used as the telephone exchange. It is intended that the building shall be ready by Sept. 1, but, in the meantime, the telephone departments are to be provided with temporary accommodation in an adjoining building. A temporary switch room will be fitted up there and preliminary operations carried on in it until the permanent switch room is completed. It has now been definitely decided to fix the inclusive rate for the use of a telephone at £5 5s. od. per annum, while the telephone installation on the toll system will be charged at £3 10s. od., with one penny per call extra. It may be added that it is a condition of the post office license that the corporation shall give the intending subscriber the option of either the inclusive or the toll system, and shall leave the choice to the individual. A few other cities are also making progress in this direction, and it is quite apparent that within a year or two the telephone industry in this country will be somewhat chaotic, and that most of the large cities will have a municipal telephone system and the system which they now have from the National Telephone Company.

YORK ELECTRIC LIGHTING WORKS.—The Electric Lighting Works, which have been erected at a cost of £20,000 by the Corporation of York, were opened recently, the opening ceremony being performed by Mrs. E. R. Dodsworth, wife of the chairman of the committee, who was presented with a silver key, bearing the city arms. The station has been erected under the advice of Professor Kennedy, consulting electrical engineer, and consists of a boiler house 55 feet by 35 feet, containing two boilers, each 28 feet long and 8 feet diameter, and working at a pressure of 125 pounds to the square inch. The engine room is 63½ feet long by 30 feet wide, and contains four engines and dynamos, two of which are about 40 indicated horse power each and two about 150-hp each. A storage battery, consisting of 250 cells, is also provided, and is situated in a battery room 47 feet by 16 feet, the present storage capacity being sufficient to run 350 8-cp lamps for about 10 hours, or 700 for about 5 hours, which enables the plant to be shut down for a portion of the day and night load when the demand is not very great. The underground cables are triple concentric armored, and insulated with a special compound of jute and bitumen between each set of conductors, the whole being sheathed in lead and armored with steel taping and laid direct in the ground. A chimney 180 feet high, with an internal diameter of 7 feet 6 inches at the top, has been built, and is capable of serving four times as many boilers as are at present installed. This chimney will be also used for a refuse destructor, which is at present being built, and it is expected that the heat generated by the burning of the city refuse will be sufficient to generate steam for the day load. Mains have already been laid along the principal thoroughfares, and besides the demand for lighting civic and municipal buildings there are already a large number of customers who are desirous of obtaining lamps. The price at which current is to be supplied is arranged on what is known as the rebate system—the consumer having a rebate allowed him in the price per unit after one hour's average daily consumption. After the first 182 hours' consumption per half year he is charged 7d. per unit and 3d. per unit on the remaining consumption per half year. For consumers using more than 5000 units per annum the corporation has adopted the following tariff: Over 5000 units and not more than 10,000 units, 7d. per unit for the hour's standard demand and 2½d. per unit for all beyond the standard consumption of one hour per day; over 10,000 units and not more than 15,000 units, 7d. and 2d.; over 15,000, 7d. and 1½d. The contractors for the building were Messrs. Parker & Sharp, of York; the machinery was laid down by Messrs. Crompton & Co., London, and the underground cables and mains by Messrs. Callender & Co., London.

General News.

THE TELEPHONE.

ADRIAN, MICH.—The Adrian Telephone Company has increased its capital in the sum of $20,000.

ST. LOUIS, MO.—The Mugg Telephone Company has increased its capital stock from $5000 to $10,000.

BERLIN, MD.—The Citizens' Telephone Company will extend its lines to Snow Hill, 16 miles distant.

PIEDMONT, W. VA.—The Union Telephone Exchange, of Keyser, W. Va., will put in an exchange here.

COLUMBUS, OHIO.—The Citizens' Telephone Company has increased its capital from $10,000 to $30,000.

PORT ARTHUR, TEXAS.—The Port Arthur Telephone Company has been incorporated, with a capital of $5000.

SNOW HILL, MD.—The Worcester Telephone Company will construct a line to Stockton and Pocomoke City.

CADIZ, IND.—Fifty farmers have established a telephone service in Henry County, with this city as headquarters.

LARNED, KAN.—The Larned Telephone Company, of Larned, has been incorporated, with a capital stock of $1000.

COLUMBUS, OHIO.—The Miller City Telephone Company will extend its lines at once to take in the rural districts.

MOORESVILLE, N. C.—The Mooresville Telephone Company, with capital stock of $5000, has been organized by S. C. Rankin and others.

TWO RIVERS, WIS.—The council has granted a franchise for 15 years to the Two Rivers Telephone Company, the yearly charge for each instrument to be $12.

CITY OF MEXICO, MEX.—The long distance telephone line of the Mexican Telephone Company, between Puebla and the City of Mexico, has just been completed.

PRESTON, MINN.—The recent report that John Kingsley had been granted a 20-year telephone franchise here is incorrect. No such franchise has been asked for or granted.

CARLYLE, ILL.—Mr. J. W. Wells, owner of the Clinton County telephone system, sold out his interests to F. W. Willard and Edward Sampson, both of Anna, Ill. Extensions will be built.

WEST ALEXANDRIA, OHIO.—The West Alexandria Telephone Company has been incorporated. Capital, $3000. Incorporators: J. E. Davis, W. H. Brubakes, G. W. Ehles, O. E. Dyer, J. Winkleman.

COLUMBUS, IND.—Steps are being taken to connect Nashville and this place with telephone service. Brown County, of which Nashville is the county seat, has neither railway nor telephone service.

SAN FRANCISCO, CAL.—San Juan Island, in the state of Washington, will soon have a long distance telephone system connecting its principal points. Work has already been commenced on 21 miles of the lines.

PHOEBUS, VA.—The Phoebus Telephone Company has been incorporated. Capital, $10,000. Incorporators: A. M. Hanger, A. Heinckel, both of Phoebus; W. J. A. Cumming, J. V. Bickford, J. W. Lee, all of Hampton.

BALTIMORE, MD.—The Eastern Shore Telephone Company has given a mortgage for $100,000 to secure the payment of 200 $500 5 per cent. gold bonds that are to be issued to obtain money for extensions and betterments.

KOKOMO, IND.—The city council granted to W. H. Turner, of North Vernon, a franchise for an independent telephone system here. The maximum rates will be $2 a month for instruments in business houses and $1.50 for residences.

CARBONDALE, ILL.—The Carbondale Telephone Company, owned by Messrs. J. B. Bunday and D. M. Parkinson, has been granted a franchise for Jackson County, permitting the company to extend its lines over the entire county.

INDIANAPOLIS, IND.—Mayor Taggart has called for a conference with the telephone and telegraph companies for the purpose of putting a stop to violations of the contract which requires that wires shall be put underground in the prescribed district.

BURLINGTON, VT.—The Addison & Panton Telephone Company has been formed at Vergennes, officered as follows: F. E. Sears, president; L. C. Seegar, secretary and treasurer; and F. E. Sears, L. C. Seegar, H. W. Spooner, E. A. Field and R. H. Noonan, directors.

NORTH YAKIMA, WASH.—The Inland Telephone & Telegraph Company has been granted a franchise to erect pole lines in North Yakima, Wash. The town will soon have connection with Spokane, Tacoma and Seattle, via the long distance lines of the Sunset system.

TELEPHONY IN GUATEMALA.—The International Telephone line between Guatemala and Salvador has been completed as far as the Salvador frontier to Jalpatuaga. The construction of the line from San Salvador to the Guatemalan border is progressing rapidly.

CINCINNATI, OHIO.—It is expected to have everything in readiness to cut in the Freeman branch of the new Cincinnati telephone system by April 15; Central and Covington will come within two months later. Walnut Hills has been in working order for a month or more.

CHICAGO, ILL.—The Chicago Telephone Company will reduce rates. The charge of $125 a year for private telephones will be cut to $100, the present highest rate for residence telephones, and a uniform toll of 10 cents will be established between all points within the city limits.

ELKHART, IND.—Seventy-five farmers of this county have organized a telephone company. Twenty miles of wire will be strung connecting with their several homes. There will be no dividends or profits declared, each member contributing annually for the maintenance of the lines.

INDIANAPOLIS, IND.—A mortgage for $800,000 was filed by the New Telephone Company in the county recorder's office in favor of the Central Trust Company and William F. Churchman. It is to secure the payment of bonds maturing in 1920. It covers all the company's franchises and property.

BALTIMORE, MD.—A bill has been introduced in the legislature to incorporate the Columbia Telephone & Telegraph Company, with a capital stock of $75,000, with power to increase to $2,000,000. Incorporators are: Andrew D. Jones, David M. Newbold, Charles A. Webb, Lloyd L. Jackson and others.

DOVER, DEL.—By a traffic agreement between the Bell Telephone Company and the Diamond State Telephone Company of this town, the present long-distance line from Dover to Wilmington, and from Elkton, Md., to Wilmington, has been turned over to the Diamond State Telephone Company.

ALBANY, N. Y.—The Madison & Onondaga Telephone & Telegraph Company has been incorporated. Capital, $20,000. Incorporators: F. E. Dawley, W. T. Gaynor, E. Woodworth, P. H. Smith, H. B. Clark, A. G. Carr, all of Fayetteville; D. G. Gates, of Chittenango; H. B. Clark, attorney, Syracuse.

COLUMBIANA, OHIO.—The Columbiana County Telephone Company, which has exchanges and toll lines in all the towns in this county, is endeavoring to extend its system into Stark County. Franchises have been applied for in Canton and Alliance, and if these are secured the toll lines will also be extended.

DOVER, DEL.—Among the recent incorporations here is the American Multiplex Telephone, Telegraph & Cable Company, of Boston, Mass. The capital stock of the company is $1,000,000, and the incorporators are George N. Phelps, Brookline, Mass.; Clinton E. Dolbear, Hyde Park, Mass.; Martin E. Smith, Wilmington, Del.

LAPORTE, IND.—George F. Trier, of Fort Wayne, general manager of the National Telephone Company, has issued a statement showing that 700 stations in Michigan, Ohio and Indiana are yielding a good revenue, this number being a gain of 400 per cent. over the number in operation a year ago. The company has 650 miles of wire in service.

DENVER, COL.—The Colorado Telephone Company has obtained a 20-year franchise from the town of Silverton. The company recently sold $50,000 worth of stock in New England, and with this money will extend the system to a highly prosperous section of Colorado, including the farming regions at Grand Junction and the mining districts in San Juan section.

KOKOMO, IND.—William N. Turner, recently granted a 20 years' franchise to operate the Citizens' Telephone in this city, to connect with the New Independent Long Distance Telephone Company, of Indianapolis, has filed the required bond endorsed by the Boston Surety Company. The new company has 254 subscribers and only part of the city has been canvassed.

BOSTON, MASS.—The Bell Telephone Company has issued the following statement of instruments in use during the month ending March 20:

	1900.	1899.		
Gross output	$65,878	$67,033	Dec.	$1,555
Returned	20,664	13,530	Inc.	7,134
Net	$45,214	$53,503	Dec.	$8,289
Outstanding	1,700,464	1,246,365	Inc.	454,099

NEW PHILADELPHIA, OHIO.—The New Philadelphia Home Telephone Company, organized last fall, has practically completed its construction work and the system will be connected up in a few days. Three switchboards of the American Electric Telephone Company's "express system" of 100 drops each have been installed and orders for two more of the same size have been placed. Five cable lines run from the exchange, each cable carrying 200 wires. The system owned by the company is to cover the whole of Tuscarawas County and exchanges are being installed at Urichsville, Dennison, Dover, Newcomerstown and Mineral Point. The company will have long distance connection through the United States Telephone Company. The rates charged by the company are $12 per year for residences, and $24 for business houses. Three hundred subscribers have been secured in this place.

ELECTRIC LIGHT AND POWER.

ADEL, IOWA.—An electric light plant is proposed for this place.

COOPER, TEXAS.—An electric light plant is to be established here.

TAMPA, FLA.—Robert Muggee will enlarge his electric light plant, installing two new dynamos.

VICTORIA, MEX.—The work of installing the new electric light plant at this place has been completed.

BRAIDENTOWN, FLA.—The Lyle Manufacturing Company will add an electric light plant during the summer.

TALLAHASSEE, FLA.—The city has awarded a contract for the construction of its municipal electric lighting plant.

SMITH'S FALLS, ONT.—The Citizens' Electric Company, of Smith's Falls, has been incorporated, with a capital of $35,000.

EASTMAN, GA.—The city has voted to issue $15,000 in bonds for the construction of water works and electric light plant.

MOREHEAD, KY.—W. J. Rice wants to correspond with manufacturers of electric light plant equipments; also with contractors.

WORCESTER, MASS.—W. H. Harvey has prepared plans for the proposed addition to the power station on Sutton Lane, to cost $12,000.

OWENSBORO, KY.—The city has engaged F. F. Vater, of Chicago, to prepare plant and specifications for its proposed electric lighting plant.

ABBEVILLE, S. C.—The Abbeville Electric Light & Power Company is in the market for 75-hp boiler and engine, with auxiliary apparatus.

HOUSTON, TEXAS.—The date of opening bids for the erection of the electric light and power plant in this city has been postponed to April 20.

YREKA, CAL.—The Yreka Electric Company is enlarging its plant with a 150-kw Stanley, two-phase dynamo and two 24-inch McCormick turbines.

DUNDEE, N. Y.—At the recent charter election in this village the "Citizens' " ticket was carried. It favored municipal electric light and water works.

GRANT'S PASS, ORE.—It is proposed to give the citizens an opportunity to vote on the question of bonding the city for an electric light and water system.

SAG HARBOR, L. I.—The electric light plant for this village is being rapidly pushed to completion and the lights will probably be burning by April 15.

MONTGOMERY, W. VA.—The Kanawha Electric Company will build a power plant to supply its proposed electric railway. E. W. McCormick is manager.

JEFFERSONVILLE, IND.—The question of municipal ownership of the electric light plant will be an issue in the coming election of councilmen at Jeffersonville.

GRAND FORK, N. D.—It is stated that the Grand Forks Gas & Electric Company will expend about $25,000 in the erection and equipment of a new electric light plant.

TRENTON, N. J.—The State Assembly has passed the bill permitting cities to purchase or erect their own electric light and gas plants for the lighting of streets and public buildings.

PEORIA, ILL.—The Illinois Lighting Company, of Peoria, has been incorporated. Capital, $2000. Incorporators: R. L. Pasquay, J. G. Meyer, E. C. Pfeiffer, all of Peoria.

BIRMINGHAM, ALA.—The Consolidated Electric Light Company has commenced work on an addition to its plant which, when completed, will represent an expenditure of $200,000.

SPRINGFIELD, OHIO.—Mr. Luke Lilly, a Cincinnati electrical engineer, is preparing estimates for a municipal lighting plant in this city. The city has about decided to install such a plant.

MARION, IND.—The Marion Electric Company is looking for a site for its plant. The company was recently organized. The principal stockholders are Benjamin F. Burk and William H. Anderson.

ELKHART LAKE, WIS.—The Elkhart Lake Light & Power Company has completed arrangements for supplying the city of Kiel with electric light and power. The line will be constructed at once.

EAST LIVERPOOL, OHIO.—The People's Light & Power Company, of this city, has been incorporated. Capital, $25,000. Incorporators: C. A. Smith, A. G. Mason, J. A. Flood, J. E. McDonald, W. L. Smith.

TRENTON, ILL.—The city of Trenton, Ill., has purchased the electric light plant from the Trenton Light & Power Company. The consideration was $10,000. The city will operate the plant beginning April 1.

HOUGHTON, MICH.—The Peninsula Electric Light & Power Company has voted to increase its capital stock 20 per cent. to $300,000, the proceeds of sale of new stock at par to be used in enlarging the equipment.

MILBOURNE, N. C., is to have a new and large electric plant. Agents of the company have been in New York, purchasing dynamos and the necessary machinery. Water power will be derived from the New River.

ATLANTA, GA.—The Atlanta Railway & Power Company has let the contract for the new electric lighting and power plant. J. T. & J. N. Brown, local contractors, have charge of the construction of the plant.

BROADALBIN, N. Y.—Bids are wanted April 15 for the construction of an electric light plant, including a dam 14 feet high and 300 feet long. J. W. Cleveland is engineer in charge. The work will cost about $10,000.

FLUSHING, L. I.—The New York & Queens Gas & Electric Company contemplate making extensive improvements to its plant here, and the board of directors has authorized the expenditure of $31,000 for this purpose.

YARDLEY, PA.—The Yardley Electric Light, Heat & Power Company has been incorporated. Capital, $25,000. Incorporators: E. J. Moore, S. J. Moore, Jr., T. A. Royal, Jr., J. MacFadden, R. Remont, all of Philadelphia.

SAN FRANCISCO, CAL.—The Utica Electric Company, of San Francisco, has been incorporated. Capital, $10,000. Incorporators: J. V. Eichbaum, F. H. Eichbaum, J. W. Wright, H. Brooks, B. B. Rosekars, all of San Francisco.

BAKER CITY, ORE.—It is reported that a Boston syndicate is building a dam on the Payette River, 35 miles above the town of Payette, where an electric power house will be built. This power will be used largely for irrigation work.

LE ROY, N. Y.—The Le Roy Gas & Electric Company has purchased the old Haskins mill, together with its water privilege, and will use the water power for the operation of its plant. The plant will be equipped with modern apparatus.

LITTLETON, N. C.—The Montauk Water & Electric Power Company has applied for a charter. The officers are: John P. Leach, president; Eugene Johnston, secretary, and W. Lea Powell, treasurer. W. C. Riddick, consulting engineer.

HAILEY, IDAHO.—An electric light and power plant is to be built this spring. The water power of the Wood River is to be utilized. New York investors are backing the proposition, and the company will be incorporated under New York laws.

SAN FRANCISCO, CAL.—The Cape Nome Electric Light & Telephone Company has been incorporated, with a capital of $150,000. Incorporators: D. Rich, E. Folger, C. S. Benedict, E. Holland, all of San Francisco; C. S. Rosener, of Nome, Alaska.

BELLEVILLE, ILL.—The lighting committee of the city council will consider the project for municipal lighting and the proposition of the Belleville Gas & Electric Light Company to furnish lights for the next 10 years at reduced compensation.

RAUBSVILLE, PA.—Hally S. Cavanaugh has purchased for the Lehigh Power Company, of Easton, Pa., a tract of land on which the new power house is to be erected to utilize the water power in the canal in generating electricity for commercial purposes.

ST. LOUIS, MO.—The contract for electric lighting in the conduit section of the city for a term of 10 years was awarded to the Seckner Contracting Company, of Chicago, March 27. The bond of $100,000 which the company deposited was also approved.

SIEGFRIED, PA.—The Northampton County Electric Company has been incorporated. Capital, $1000. Incorporators: L. Flick, O. Lincoln, both of Wilkesbarre; H. T. Hyndman, W. W. Watson, W. E. Sullivan, all of Scranton; W. L. Watson, of Cementon.

CATASAUQUA, PA.—The Lehigh County Electric Light Company of Catasauqua has been chartered. Capital, $1000. Incorporators: L. Flick, O. Lincoln, both of Wilkesbarre; H. T. Hyndman, W. W. Watson, both of Scranton; W. L. Watson, of Cementon.

MERCHANTVILLE, N. J.—The plants of the Merchantville Light, Heat & Power Company and the Merchantville Gas Company are reported to have been purchased by the Camden & Burlington Gas & Electric Company. Extensive improvements will be made to the plants.

VANCOUVER, B. C.—The Starr Lake Power Company has been incorporated for the purpose of transmitting electric power from Starr Lake Falls to the city of Vancouver, a distance of 42 miles. At least 3000-hp will be developed. Mr. J. B. Ferguson may be addressed.

LOS ANGELES, CAL.—The Sierra Power Company has been incorporated, with Los Angeles, Cal., as the principal place of business. The directors are: C. G. Baldwin, of Clairmont; J. Albert Dole, B. S. Nichols, A. W. Burt and A. P. Nichols, of Pomona. The capital stock is fixed at $75,000; subscribed, $58,500.

SALEM, ORE.—The Salem city council is considering favorably the electric lighting franchise asked for by F. R. Anson. The ordinance carries amendments, requiring a bond of $1000 to have the proposed plant in operation before Jan. 1, 1901, and to pay to the city regularly 2 per cent. of the gross earnings of the system.

PARKERSBURG, W. VA.—The St. Mary's Water & Light Company, of St. Mary's, Pleasants County, has been chartered. The subscribed capital is $50,000. The authorized capital is $1,000,000. The incorporators are Robert L. Gregory and Eston Randolph, of Sissonville; John B. Duffy, James Duffy and Harry Duffy, of Washington, D. C.

READING, PA.—Councils have awarded the electric light contract for five years, from this month, to the Metropolitan Electric Company, for $79.72 per arc light per annum, on the basis of 700 lights. It is proposed to do away with the incandescents almost entirely, although new bids will be received for 100, 200 and 300 of these lights respectively.

SPRING VALLEY, N. Y.—The Spring Valley Gas & Electric Company, of Spring Valley, has been incorporated. Capital, $40,000; Incorporators: G. H. Dunlap, J. D. Dunlap, both of Spring Valley; F. B. Poor, of Hackensack; H. L. Hewit, A. L. Fernald, both of New York City; W. C. Thomas, S. Taylor, both of Hackensack, N. J.; W. McCauley, Jr., attorney, Haverstraw.

LEADVILLE, COLO.—The city council will submit an ordinance to a vote at the coming city election as to whether or not Leadville shall have another electric light company. The firm which asks for a franchise is that of Gilbert, Wilks & Co., electrical engineers, of Detroit and Denver. They promise a reduction of 40 per cent. in charges and ask for a 20-year franchise.

FALL RIVER, MASS.—At the annual meeting of the stockholders of the Fall River Electric Light Company, the following officers were elected, the president by the directors: President, Frederick O. Dodge; clerk, Owen Durfee; treasurer, Albert F. Dow. Directors—Frederick O. Dodge, John D. Flint, Edward L. Anthony, Oliver S. Hawes, Rufus W. Bassett, James E. Osborn, Jerome C. Borden, James B. Harley.

PHILADELPHIA, PA.—It is rumored that the Consolidated Electric Company has secured control of the Wayne Electric Light and the Haverford Electric Light companies. If this is the case the company now controls 17 concerns in this state and practically all the electric lighting field on the main lines of the Pennsylvania and the Reading within fifty miles of this city. The capital stock is to be increased to $4,000,000.

OTTAWA, ONT.—All of the Eddy Company's saw mill, wood working, match making and paper manufacturing plants in Ottawa will, before the close of the present year, be operated by electricity. The power will be obtained from the Conroy Milling Company, whose lumber and grist mills are situated on the Ottawa River, about three miles above the Eddy establishments. Construction work is now being carried on, and it is expected fully 8000-hp will be supplied to the Eddy Company.

NEW ALBANY, IND.—The New Albany Light & Water Company was organized and incorporated at New Albany March 23, with a capital stock of $25,000. George Steinhauer, of New Albany, was elected president; C. S. Knight, of Fort Wayne, secretary, and George Borgerding, of New Albany, treasurer. A franchise was granted by the New Albany city council the same day. The company has an option on the New Albany Light, Heat & Power Company's plant, and will make a proposition to sell it to the city.

SAN FRANCISCO, CAL.—The Electric Improvement Company, San Jose, Cal., recently closed contract with the General Electric Company for a 400-kw, three-phase generator. It will be direct-connected to a McIntosh & Seymour engine, which will make 100 r. p. m. This will constitute a steam relay for the company's lighting and power system. The frequency will be 60 cycles, in order to correspond to that on the transmission lines of the Standard Electric Company, which will supply the Improvement Company with current from Blue Lakes some time during the present year.

THE ELECTRIC RAILWAY.

CINCINNATI, OHIO.—The Findlay Street Railway has declared a dividend of ¾ per cent., payable April 10.

GREEN BAY, WIS.—The Fox River Valley Electric Railway & Power Company will erect a large car barn in this city.

HAGERSTOWN, MD.—The Hagerstown & Frederick Railway Company is considering the adoption of electric power on its line.

NORFOLK, VA.—The Norfolk Street Railway Company has put on its Lambert's Point & Norfolk line separate cars for negroes.

NASHVILLE, TENN.—The People's Electric Railway Company has been organized to build an electric line in the city and suburbs.

KOKOMO, IND.—The Central Traction Company has been incorporated, with a capital of $1,200,000, and headquarters at Anderson.

WALTHAM, MASS.—The Waltham, Wayland & Weston Street Railway Company has petitioned the Board of Aldermen for a franchise.

HUBBARD, OHIO.—The village council has granted a right of way through the town to the Youngstown & Sharon Electric Railway Company.

CITY OF MEXICO, MEX.—Jose Garcia and Ernesto Diaz Rugama have obtained a concession for building a new street railway in this city.

WATERBURY, CONN.—The Connecticut Lighting & Power Company has resumed operations on the new trolley extension from the west end to Oakville.

MONMOUTH, ILL.—Warren County's supervisors have granted a 20-year franchise and right of way to the Galesburg & Monmouth Electric Railway Company.

LENOX, MASS.—The Lenox Street Railway Company has petitioned the board of selectmen for a franchise and location for its tracks in the town of Lenox.

WASHINGTON, N. J.—The Phillipsburg Street Railroad Company has petitioned the council for a franchise to construct a trolley line through the borough.

HARRISBURG, PA.—The Harrisburg Traction Company has practically increased the wages of its employees about 10 per cent. under a new rule recently adopted.

ALBANY, N. Y.—Governor Roosevelt has vetoed the bill to facilitate the construction of trolley roads in Queens and Nassau counties without consent of the people.

CAMDEN, N. J.—The Riverton Borough Council has granted permission to the Camden & Trenton Railway Company to construct a trolley road within the borough limits.

DETROIT, MICH.—The new power house which is to furnish the power for the electric railroad from Detroit to Port Huron is almost completed at New Baltimore.

SYRACUSE, N. Y.—Mr. E. G. Connette, of Nashville, Tenn., has been appointed general manager of the Syracuse Rapid Transit Railway Company, Syracuse, N. Y.

KOKOMO, IND.—The Central Traction Company, proposing to build an electric line between Kokomo and Indianapolis, has applied to Noblesville for a 50-year franchise.

CEDAR GAP, MO.—The citizens of Cedar Gap, Wright County, and Ava, Douglas County, are discussing the proposition to build an electric railway to connect these towns.

LOCKHAVEN, PA.—The Lock Haven Traction Company was sold at foreclosure sale on March 28. The property was purchased by W. B. Given, of Columbia, for $34,700.

IRONTON, OHIO.—The Ironton Electric Light & Railway Company's property was sold at auction on March 14. It was purchased by a syndicate headed be ex-Senator Camden.

WARREN, OHIO.—The Warren city council has passed an ordinance fixing the speed limit of street cars at 12 miles an hour, with six miles an hour as the maximum speed for grades.

LYNCHBURG, TENN.—Peter Klein and E. D. Terry, of Aurora, Ill., and J. Y. Garlington, of Atlanta, Ga., are interested in the proposed electric line between Lynchburg and Wartrace.

SPRINGFIELD, MASS.—An attempt is being made to revive interest in the project of the Springfield & Southwestern Street Railway, which was organized to connect this city with Hartford.

DUBUQUE, IOWA.—The car house of the Dubuque Street Railway Company was destroyed by fire recently. The loss is estimated at $25,000, with $15,000 insurance. Five cars were destroyed.

BOWLING GREEN, OHIO.—The Toledo, Bowling Green & Fremont Electric Railway Company has been completed, and is operating its cars as far as Jerry City on the route to Fremont.

ALEXANDRA, IND.—The Union Traction Company is erecting a large building here, to cost $30,000, to be used for the storage batteries for the lines between this point, Elwood and Marion.

CLEVELAND, OHIO.—The Little Consolidated Street Railway Company, which operates electric lines and cable lines in this city, is making arrangements to change the motive power on the latter.

ST. LOUIS, MO.—The St. Louis & St. Charles Railroad Company has let the contract for the extension to Pattonville. The road will reach the Missouri River opposite St. Charles in a very short time.

GRAND RAPIDS, MICH.—Dr. Mark Cummings has sold the Consolidated Street Railway Company of Grand Rapids, Mich., to a syndicate represented by E. W. Clark & Co., of Philadelphia, for $3,500,000 cash.

CLEVELAND, OHIO.—The directors of the Cleveland Electric Railway Company have declared a quarterly dividend of 1 per cent., payable April 5. This is the second dividend since the strike of last summer.

PITTSBURG, PA.—The Monongahela Traction Company has contracted for 105 new cars, to meet the increased travel on its old lines as well as to be used on the extensions the company has been making during the winter.

GALVESTON, TEX.—Julius Runge, of Galveston, has closed a deal to secure control of the Galveston City Street Railroad from the Guaranty Trust Company, which recently purchased the property under foreclosure.

IRON MOUNTAIN, MICH.—The Marinette Electric Light & Street Railway Company has applied for a franchise from the town of Peshtigo for the right to construct an electric railroad line from Marinette to Peshtigo.

ALBANY, N. Y.—The law and legislative committee has been instructed to draft a bill for presentation to the legislature requiring the Metropolitan Street Railway Company, of New York, to reduce its car fare to three cents.

CITY OF MEXICO, MEX.—A Mexican woman was recently caught in the act of removing trolley wire from the posts along the trolley road in the suburbs. She was sentenced to 22 months' imprisonment for the offence.

DETROIT, MICH.—Judge Swan has handed down an opinion in the case of the Citizens' Street Railway Company against the city, granting a perpetual injunction against the city from enforcing the three-cent fare ordinance.

CIRCLEVILLE, OHIO.—The county commissioners of Pickaway County have decided to grant a franchise to the Chillicothe, Mt. Sterling & Columbus Electric Railway Company over one of the two routes applied for recently.

SHELBYVILLE, IND.—The Shelbyville Street Railway, Light & Power Company has been incorporated. Capital, $25,000. Incorporators: J. D. Pugh, J.

A. Tindall, E. K. Adams, A. J. Murston, J. H. Akers, A. Deprez, all of Shelbyville.

PARKERSBURG, W. VA.—The Citizens' Traction Company has been incorporated. The incorporators are J. L. Cramer, G. B. Gibbens and C. D. Forrer, of Parkersburg; A. Williams, of Salama, W. Va., and L. Cramer, of Clarington, Ohio.

MILBRIDGE, ME.—The Milbridge & Cherryfield Electric Railway has been incorporated with a capital stock of $60,000. The directors of the road are Frederick Yates, C. E. Goodwin, J. O. Bradbury, F. K. Wilson, J. G. Gay and E. A. Hubbard.

INDIANAPOLIS, IND.—The Central Traction Company, of Anderson, has been incorporated. Capital, $1,200,000. Incorporators: H. C. Stilwell, G. Lally, both of Anderson; C. A. Ford, of Kokomo; W. L. Kann, of Pittsburg, Pa.; S. J. Mack, of Indianapolis.

CHICAGO, ILL.—It is reported that the Chicago Electric Traction Company, the only storage battery line in Chicago, will substitute the overhead trolley system in the next few weeks. The change will be made as fast as the trolley system can be installed.

BALTIMORE, MD.—A bill has been introduced in the Legislature incorporating the Baltimore County & City Railway Company, with a capital stock of $50,000, to construct an electric suburban and city railway. Incorporators: Richard P. Choate, John S. Waters and others.

NASHUA, N. H.—Surveyors have commenced work upon the route of the Hudson, Pelham & Salem Electric Railroad, which will connect this city with Haverhill, Mass. The power station will be located at Pelham Junction. Some 21 miles of the road will be built in this state.

CHICAGO, ILL.—The city council passed the ordinance compelling the street railway companies to lower the tunnels under the river at their own expense. The work must be begun within three months and must be finished within a year from the date of passage of the measure.

EASTPORT, ME.—With the recent organization of the Eastport Street Railroad Company here, and the election of officers, there are strong indications of the road being built during the year about the city. A connecting line to Calais, 28 miles up the St. Croix valley, will be built later.

OSHKOSH, WIS.—It seems probable that an electric railway will be built this summer to connect this city with the villages of Imro, Eureka and Waukon, and the city of Berlin. The real estate board has taken active hold of the matter and with the co-operation of the merchants is pushing it.

INDIANAPOLIS, IND.—The Indianapolis & Greenfield Rapid Transit Company has filed a mortgage for $150,000, covering its property and franchises, to the Savings & Trust Company, of Cleveland, Ohio, and L. W. Prior, trustee. It is to secure bonds to raise funds for improvement of the line.

NEW HAVEN, CONN.—A project is afoot for uniting the trolley roads centering at Bridgeport, including the Shelton Street Railroad line reaching to Ansonia, Derby and Shelton, so that they may deliver freight at a Bridgeport wharf for transportation to New York by a new freight-steamboat line.

CHICAGO, ILL.—C. I. Yerkes has been elected chairman of the board of Northwest Elevated. E. L. Brewster resigned as vice-president and director, Clarence Buckingham succeeding him. Bryan Lathrop and C. L. Blair also resigned. Charles Counselman, J. B. Dennis and Mr. Yerkes succeeded them.

PITTSBURG, PA.—The new power house of the Monongahela Electric Light & Power Company, which has been building at Rankin Station, is now completed. It has a capacity of 3600-hp, consisting of the latest and most improved machinery, furnished by the Westinghouse Electric & Manufacturing Company.

PHILADELPHIA, PA.—The Inland Traction Company, which proposes to build a trolley line paralleling the North Penn, from Allentown to this city, will shortly connect with the Quakertown Traction Company, thus forming a complete line from Quakertown to Lansdale. Later it will be extended to Chestnut Hill.

NEW YORK, N. Y.—The New York, Brooklyn & Jersey City Rapid Transit Company has been incorporated. Capital, $60,000. Incorporators: G. Wilson, A. H. Mullen, F. N. Glove, J. M. Muller, all of New York City; J. La Burt, of Jamaica, L. I.; Etta L. Foulk, of Brooklyn; F. N. Grove, attorney, New York City.

NEW YORK, N. Y.—The Metropolitan Street Railway Company has made application to the Municipal Assembly for franchises for its proposed connecting railways in Tenth street from Sixth avenue to Greenwich avenue, and in Broadway from Eighth avenue and Fifty-ninth street to Columbus avenue and Sixty-fourth street.

ST. CLOUD, MINN.—E. E. Clark was appointed temporary receiver for the Benton Power & Traction Company. The motion was by the St. Paul Title & Trust Company, and on alleged divergence of company funds and mismanagement. The new power plant will be shut down by the receiver, and power secured by rental from the old company.

KANSAS CITY, MO.—The Metropolitan Street Railway Company closed a contract with the Brownell Car Company of St. Louis for fifty new cars. Twenty-five of these are to be delivered in Kansas City by June 20, so as to be in readiness by the opening of the Democratic convention. The company will soon close another contract for fifty more cars.

PITTSBURG, PA.—The stockholders of the Consolidated Traction Company on March 31 voted to lease their lines to the Union Traction Company, a new corporation that will take over the Consolidated, United and Monongahela Traction companies. The two last named have yet to vote on the lease question, but are in favor of it. The new corporation will be capitalized at $30,000,000.

WORCESTER, MASS.—The syndicate which is after the electric railways in and about Worcester has taken up its options on the Fitchburg & Suburban, the Clinton & Hudson, the Leominster & Clinton, and the Worcester & Clinton. It is thought probable that the Worcester Consolidated will be finally included in the purchases. Six roads have been bought. The combined capital of the four taken is $500,000.

OSHKOSH, WIS.—The sale of the properties of the Citizens' Traction Company, which has been pending for some time, was formally made on March 27. Emerson, McMillan & Co. are the purchasers. The sale includes the local electric car line and the interurban line between here and Neenah, 30 miles in all, and a park south of the city. The company was capitalized at $225,000. The purchase price is not made public.

TROY, OHIO.—A franchise has been granted here to the Dayton & Troy Electric Railway Company. It is stated that the company has offered a one-cent fare within the city limits to hold good during the life of the franchise, which is 25 years. The company claims that it can make money even at this low rate. It has already received franchises through Miami and Montgomery counties, and the work will begin at once.

NASHVILLE, TENN.—The People's Electric Railway Company, with capital stock of $100,000, applied for a charter. The company proposes to build and operate 48 miles of track in the central portion of the city and suburbs, for a franchise for 20 years, the city to purchase at its actual value at the end of that time. It also proposes to give 2 per cent. of its gross receipts for the first five years, and 5 per cent. thereafter to the city.

PHILADELPHIA, PA.—The 12-mile trolley road of the Bucks County Railway Company, between Willow Grove and Doylestown, has been sold at auction. It was bought in for $50,000 by William C. Ryan, one of the attorneys of the Doylestown Trust Company, receiver of the road, subject to a mortgage of $139,384.74. It is generally believed that control of the road will be secured by parties largely interested in the Union Traction Company, of this city.

PITTSBURG, PA.—The Monongahela Traction Company will spend $50,000 in the next few weeks, making improvements at Kennywood Park, a pleasure resort on the company's line of travel. Among the improvements to be made will be a "three-way figure 8" toboggan slide. This will be the finest in the country and cost $15,000. A baseball club will be engaged and games will be played throughout the season. There will also be erected a new dining pavilion and a new concert pavilion.

THE AUTOMOBILE.

NO AUTOMOBILES ON THE SPEEDWAY.—The bill to prohibit all heavy wagons and automobiles on the Speedway in New York City has passed the assembly.

THE AUTOMOBILE COMPANY OF AMERICA has been incorporated at East Orange, N. J. Capital, $250,000. Incorporators: G. A. Lamb, E. B. Hawkins, A. G. Brown.

THE WALDEN'S RIDGE AUTOMOBILE COMPANY has applied for charter at Chattanooga, Tenn., with the following incorporators: S. T. Dewees, W. E. Raht, T. W. Fritts, B. F. Fritts and James F. Johnston.

THE SCHAUM AUTOMOBILE & MOTOR MANUFACTURING COMPANY has been incorporated in Baltimore, Md., by William A. Schaum, Thos. Philbin, William H. Wickham, Walter S. Leutbecker and John J. Carroll. The capital stock is $50,000.

PROPOSED AUTOMOBILE ROAD.—A project is on foot to construct an automobile road from New York to the mountain region of New Hampshire. John D. Quackenbos, of New York, is the prime mover in the scheme and Gov. Rollins and N. J. Bachelder are co-operating with him.

NEW INDUSTRIAL COMPANIES.

THE DENVER GAS & ELECTRIC COMPANY, of Denver, Colo., has been incorporated. Capital, $3,500,000. Incorporators: G. Treadway Thompson, of Denver, and others.

THE COLORADO SPRINGS ELECTRIC COMPANY, of Colorado Springs, Colo., has been incorporated. Capital, $1,000,000. Incorporators: W. P. Bonbright, W. A. Otis, L. E. Curtis, all of Colorado Springs.

THE BALDWIN & ROWLAND SWITCH COMPANY has been organized in New York City to manufacture electric switches. The capital stock is $25,000. The directors of the company are: H. Rowland and R. A. Baldwin, of South Norwalk, Conn.

THE CHARLESTON ELECTRICAL SUPPLY COMPANY has been incorporated at Charleston, W. Va. Capital, $50,000. Incorporators: E. Polsne, E. C. Polsne, E. C. Merwin, all of Charleston; A. A. Atkinson, P. W. McDaniel, both of Athens, Ohio.

THE AMERICAN ELECTRIC COMPANY, of Cleveland, Ohio, was incorporated last week, with a capital stock of $3000, to manufacture electric specialties. The incorporators were J. R. McQuigg, John Coleman, J. E. Lloyd, G. B. Riley and L. G. Hopper.

THE CONSUMERS' LIGHT, HEAT & ICE COMPANY, of Newport News, Va., has been incorporated. Capital, $100,000. Incorporators: W. C. Stuart, R. W. Perkins, J. A. Hirschberg, E. Peyser, A. E. G. Klor, L. A. Myers, L. B. Reynolds, H. J. Lewis, F. Read, all of Newport News.

THE NATIONAL CABLE & WIRE COMPANY has been incorporated at Pittsburg for the purpose of manufacturing insulated wires and cables. Capital, $10,000. Incorporators: D. Carlin, A. Johnson, both of Bellevue; C. C. Henry, of Allegheny; W. J. Brennan, O. O. C. Campbell, both of Pittsburg.

THE AMERICAN AUTOCARETTE COMPANY, of Alexandria, Va., has been incorporated to manufacture and operate automobile cars, cabs, etc. Capital, $300,000. Incorporators: O. G. Staples, T. F. Schneider, E. B. Hay, L. M. Saunders, W. E. Schneider, E. Reynolds, L. S. Simmons, all of Washington, D. C.; D. Stuart, attorney, Alexandria.

PERSONAL.

MR. JAMES M. GRAVES, eastern representative for the McRoy vitrified clay conduits, is visiting friends in Chicago.

MR. C. M. LEWIS has been appointed superintendent of the Philadelphia, Reading & Pottsville Telegraph Company, with office at Reading, Pa.

MR. JAS. R. MYERS, of the firm of Robbins & Myers, Springfield, Ohio, visited Chicago last week and captured several orders for Standard ceiling fans.

PROF. H. WADE HIBBARD, of the Cornell University, accompanied by 12 students, visited the Westinghouse Electric & Manufacturing Company's works at East Pittsburg, last week.

MR. E. J. PIETZCKER, representing the American Steel & Wire Company, Chicago, leaves for the Paris Exposition the middle of April, to take charge of the company's electrical interests there.

MANAGER JACOBS, of the Triumph Electric Company, Cincinnati, Ohio, has been making business visits among representatives of the trade in New York, Cleveland, Toledo, Chicago and other cities.

MR. JOHN N. ABBOTT, who has for many years been the general passenger agent of the Erie Railroad, has been chosen vice-president and general manager of the Consolidated Railway, Electric Lighting & Equipment Company.

MR. GEORGE W. BRUMHOFF has been appointed general manager of the St. Louis Transit Company, St. Louis, Mo. Mr. Brumhoff is well known to electrical people, and is an active member of the American Street Railway Association.

MR. H. H. VREELAND, president of the Metropolitan Street Railway, New York, has resigned the position of president of the Air Power Company, of Chicago, on account of the pressure of business involved by his New York traction interests.

MR. NORMAN ROWE, who was engineer for San Francisco district agency of the Westinghouse Electric & Manufacturing Company, has been appointed managing engineer of the De Fonzo Electrical Transmission System, City of Mexico, Mexico. Mr. Rowe has already gone to Mexico.

MR. W. H. JACOB, of the Triumph Electric Company, Cincinnati, Ohio, was in New York and Boston last week. This company is extremely busy and Mr. Jacob reports a most satisfactory outlook for the future. Mr. F. R. Chinnock says the New York office is doing its full share of the business.

MR. J. MELDRUM, of Manchester, England, is on a visit to the United States, and will make a tour of the principal manufacturing centers of the country. Mr. Meldrum is the inventor of the Meldrum furnace for burning low-grade fuels, and which has been adopted for use in a number of British "dust-destructor" plants, utilizing refuse in the generation of electric power.

OBITUARY.

MR. JOHN R. BULLARD, president of the Dedham Electric Lighting Company, of Dedham, Mass., died March 16.

G. W. F. RANDOLPH, one of the pioneers associated with Mr. Edison in his early work in establishing the central station business in this city, died at his home in Plainfield, N. J., on March 24. Mr. Randolph was stationed at the Goerck Street factory in the early days of the Edison Manufacturing Company.

Trade Notes.

CARBON BRUSHES.—The Speer Carbon Company, St. Mary's, Pa., is sending out an announcement of the Speer self-lubricating brushes, samples of which will be sent to those interested.

APRIL CALENDAR.—The Bullock Electric Manufacturing Company, Cincinnati, Ohio, is distributing its April calendar card. It is of the same high artistic standard as that of its other monthly predecessors.

THE STEWART ELECTRIC COMPANY, of Cincinnati, repairs and secondhand electric machinery, does business in Kentucky, North Carolina and Tennessee, and reports the outlook very bright in all this territory.

THE ELECTRIC CONTRACT COMPANY, of 61 Elm Street, New York, has issued a leaflet on its portable battery electric light. The "Light of Asia" lamp. This lamp was described and illustrated in these columns March 31.

CROSS OIL FILTERS.—The West Virginia Pulp & Paper Company, Piedmont, W. Va., has recently ordered four 50-gallon Cross oil filters, manufactured by the Burt Manufacturing Company, Akron, Ohio, for use in its plant.

THE ELECTRIC APPLIANCE COMPANY, of Cincinnati, has determined to enlarge the capacity of its plant. Superintendent Churcher reports orders for the new telephone sufficiently large to require the almost undivided attention of the entire force.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., has issued bulletins 1006 and 1007. The subject of the former is "Wood" arc lamp suspension cut-outs and that of the latter "Wood" new focusing series arc lamps. A full description of these is given, with illustrations.

CHANGE OF FIRM NAME.—The Osborn Electric Manufacturing Company, of Chicago, Ill., on April 2, changed its name to Electric Supply Company. Mr. L. W. Jones is president and secretary of the company, which retains the old headquarters at 294 Dearborn Street, Chicago.

MR. DAVID CHALMERS, who has for some years represented the Holtzer-Cabot Electric Company, in this city, has opened an office at 136 Liberty Street, New York, where he will represent the Marietta Manufacturing Company, of Marietta, Pa., manufacturers of electric power motors.

WOODS MOTOR VEHICLES.—The Woods Motor Vehicle Company, 545 Wabash Avenue, Chicago, has issued a handsome catalogue describing and illustrating some of the types of the Woods electric automobiles. The illustrations consist of full-page and well executed lithographs in colors, there being 10 colored plates in all.

PUMPING MACHINERY.—The Deming Company, Salem, Ohio, has just issued a 30-page catalogue, in which are described pumps for all manner of service and for operation by steam, gas, oil, water and electric power. A number of illustrations and descriptions are given of electric pumping sets for house, mining and general service.

HURRICANE FAN MOTORS.—The Goldmark & Wallace Company, 121 Worth Street, New York, has issued a catalogue of the direct current Hurricane fan and power motors, as perfected for the present or fifth season of this well known type. The various types are well illustrated, among the cuts being a sectional view showing the details of construction.

THE LEA ELECTRIC MANUFACTURING COMPANY has been incorporated in Indiana. This company absorbs the Lea Manufacturing Company and the Robinson Electric Heater Company, both of Elwood, Ind. The old Lea Manufacturing Company put upon the market an enclosed arc lamp, the manufacture of which will be continued by the new organization.

THE GARTON-DANIELS COMPANY, of Keokuk, Iowa, has been unable to keep up with the orders for Garton lightning arresters, although it has recently largely increased its facilities. It hopes, however, to make prompt shipments in a few weeks. The company's business was over twice as large in 1899 as in any previous year, and it states that present indications are for a similar per cent. of increase this year.

THE JONES BROS. ELECTRIC COMPANY, of Cincinnati, is making extensive improvements in its lighting and power plant. New Sterling boilers, new Ball engines and new Westinghouse generators, etc., will bring the expense up to something like $50,000. The company reports a large increase in business since the first of the year, due to the lower rates for service. The improvements will give an increased capacity of 25 per cent.

THE COMMERCIAL ELECTRIC COMPANY, Indianapolis, Ind., has made provision to take care of the demand for high grade ventilating apparatus for the coming warm season by the production of a high class direct-connected electric fan outfit. This is built in sizes from 30 to 48 inches, and equipped with the well known "Commercial" semi-enclosed motor, which apparatus is fully described in a circular which will be sent on application to those interested.

THE O. C. WHITE COMPANY, of Worcester, Mass., has recently made some large foreign shipments of its standard adjustable fixtures. A large duplicate order was shipped a few days ago to A. Guinness, Son & Co., Dublin, Ireland, to be installed in the St. James' Gate Brewery, in Dublin. It has also made recent shipment of goods to Cape Town, South Africa, and to St. Petersburg, Russia. For the season of the year, the sale of fixtures is unusually brisk.

THE ELECTRIC GAS LIGHTING COMPANY, Boston, announces that it is now in a position to fill orders for Bryan-Marsh "Army and Navy" lamps, Grimshaw wires, Hartford snap and push-button switches, Hart switches of all kinds, and Bryant Electric Company and General Electric Company specialties, besides lines of shades of all kinds, portables, desk lamps, fan motors—in short, electric light supplies in general. These lines are in addition to the company's regular line of electric gas lighting material and house goods.

THE CHICAGO MOTOR & DYNAMO COMPANY in its organization, we are informed, is entirely different from that of the old Chicago Dynamo & Motor Company. Mr. Walter Simpson, formerly connected with the latter concern, is not now interested in the business. The company has recently been making some improvements which have resulted in its turning out a much better machine than heretofore and has increased the prices very slightly. The machines are said to be well made, are free from electrical and mechanical inherent defects and are guaranteed for two years.

GENERAL SUPPLY CATALOGUE.—The Western Electric Company has issued its 1900 general catalogue of electrical supplies. It is substantially bound in boards, has 362 pages and measures about 6 by 8 inches. It is profusely illustrated, as may be inferred from the wide field covered by its title, and prices and other information are given of the various articles tested. A very complete index of code words is given at the back, besides indices of materials and catalogue numbers. This catalogue covers everything in the line of electrical supplies, except electric light, railway and power apparatus and supplies.

LIGHTING STORE WINDOWS.—The Frink system of illumination for painting galleries has received such high endorsement, and as the up-to-date store window presents an exactly identical problem of lighting, it naturally follows that the Frink window reflector, which is the picture reflector adapted to show windows, is equally satisfactory for window lighting. It is stated that no merchant who has once used it can be persuaded to make experiments with other fixtures, while those who first try the "just as good" arrangements, frequently install the Frink reflector when enlarging or remodeling their stores.

WATER MOTORS for running fans from ¼-hp to 25-hp, built by the American Impulse Wheel Company, 120 Liberty Street, are finding quite a good sale this season. They are used to run a dynamo direct-connected or belted, and prove a great convenience for generating electric power for fans in shops, factories, etc., not already equipped with electricity. They are also used for operating static machines, elevators, lathes, saws, printing presses, air compressors, coffee grinders, graphophones, organs, etc. The water wheels are made upon the same scientific principles as the large impulse wheels which this company builds.

BELTS THAT DIDN'T SLIP.—During the recent electrical test of the Buffalo Street Railway power house under the leadership of Professor Carpenter, of Cornell, it was snowing 6 inches every hour; an ice dam had formed in the Niagara River and the Nirgara Falls power was shut off, compelling the railway company to buck the storm with power from their own engines alone, forced to top speed. The belts strained and groaned, running with great bellying sags in their non-driving sides. Not a belt slipped an inch except one that was dry, hard and shiny, with a pulley surface like glass. All the rest were full of Cling-Surface.

THE MARTIN J. INSULL COMPANY, western selling agents for the General Incandescent Arc Light Company, announces its removal about May 1 from the Monadnock Building, in Chicago, to No. 48 West Jackson Boulevard, where a large stock of G. I. products can be carried. The General Incandescent Arc Light Company is now carrying standard lines, such as arc and incandescent lamps, switches, fans, etc., in stock at all of its offices. A gratifying increase in its southern trade has led the company to move its Charlotte (N. C.) offices into larger quarters. They are now at home in the Y. M. C. A. Building, where a stock is carried.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, has received a hurry cable order from Paris for a duplicate direct-connected generator and switchboard intended to provide power for the entire machinery exhibit in the American (Vincennes) section of the exposition. The original machinery was shipped on the French line steamer Panillac, now so long overdue that she has been given up as lost. As the entire Vincennes annex depends for power on this machine, the result will be a general embarrassment and delay. The Bullock Company will bend every energy to have the duplicate generator ready for shipment in 30 days.

THE McCAY ENGINEERING COMPANY, Baltimore, Md., has been lately receiving many orders for its many electric heating devices, especially electric flat irons, the construction of which allows these irons to be repaired, if anything happens to them, by the user himself. The heating coil is separated from the outside shell by a specially prepared silica which prevents the heating coming in contact with the outside shell, and gives a very even heat over the entire iron. Inquiries have been received in response to their advertisement from all over the world, and their factory is now busy with a large order for the city of Philadelphia, where electric irons are used to a large extent.

THE MICHIGAN ELECTRIC COMPANY, Detroit, Mich., is doing a rushing supply business and also recently closed several important engineering contracts. As exclusive Michigan agent for the Electric Storage Battery Co., it has secured an order from the Detroit Citizens' Street Railway Company for a 1500-kw installation of storage batteries. This will be the second largest storage battery installed in this country, the complete plant representing $200,000. The Michigan Company is now constructing a mammoth electric sign for Hiram Walker & Sons, of Walkerville, Ont., which will be 90 feet long and 60 feet high, costing $6000. It will contain more than 3000 lamps outlining the words "Distillery of Walkerville," "Canadian Club."

ISOLATED ELECTRIC PLANT IN A DRY GOODS STORE.—An isolated electric lighting plant has been installed in the dry goods house of James McCreery & Co., at Broadway and Eleventh Street, New York. Two direct current American Ball generators are directly connected to American Ball duplex compound engines, of 200-hp and 85-hp. These engines are lubricated by the automatic oiling system, which keeps every part of the machinery oiled from a central tank. The plant includes a large switchboard, with 25 switches ranging in capacity from 50 amperes to 4000 lights. The entire plant was constructed and installed under the supervision of Mr. Felix Gottschalk, the chief engineer of the firm, and is now in operation.

FAN MOTORS.—The Emerson Electric Manufacturing Company, St. Louis, Mo., in order to give customers prompt and satisfactory service during the coming fan motor season, doubled its factory capacity last fall, and has been making a stock of fan motors and ceiling fans for some months. In making up this stock, the object has been to make the assortment for such voltages and alternations as its records show are most generally called for. A postal card is being sent out, however, which shows the regular windings as listed in its catalogue, but purchasers are asked to name the voltage and alternations if their current is different from the regular stock windings. In that case windings suitable for any alternating current will be furnished.

THE ARNOLD ELECTRIC POWER STATION COMPANY has just issued two bulletins describing two of the principal plants installed on this company's system. Bulletin No. 1, relates to the Chicago & Milwaukee Electric Railway, and bulletin No. 2, describes the central station of the Imperial Electric Light, Heat & Power Company, of St. Louis, Mo. These two bulletins show the class of work done by the Arnold Company and indicate the methods followed in designing and building complete electric properties. Engineers in general will be interested in these bulletins, as containing in convenient shape for reference technical descriptions of important plants. Copies may be obtained free by addressing the company, 1540 Marquette Building, Chicago, Ill.

STUART-HOWLAND COMPANY, an electrical supply house, will open April 1 at 283-285 Devonshire Street, Boston, Mass. The firm is organized under the laws of the state of Maine, with a capital stock of $100,000, with $40,000 fully paid in and $10,000 more to be paid within the next six months. It will do a general electrical supply business, and with four able salesmen on the road and a liberal business policy this company promises to become a leader in the electrical supply business, especially in the East. It soon expects to branch out, however, and take in Canada as well as the west and south. Both Mr. Stuart and Mr. Howland are well known to the electrical trade, having both been in the electrical business for years. They have a large circle of friends and were assured of the business of several large companies in the east before they opened up their store.

THE FRANK REDLON COMPANY, of Boston, Mass., has, with respect to facilities, accuracy and reliability of work, one of the most completely equipped repair shops in the east. This company keeps a large number of spare armatures on hand for cases of emergency. Armatures for dynamos and motors almost any make or capacity, are to be found in their shops. They also keep a large stock of coil windings on hand, windings suited for each make and capacity of machines. Their specialty is the rewinding of armatures for street railway motors. They have capacity for taking care of all the repair business in New England, outside of the large companies which do their own repair work. One unique feature of this company is their maintenance department. They have about 300 motors and dynamos in and about Boston whose operation they guarantee to the owner at a nominal figure. Mr. E. W. Kellogg, the manager of the company, states that the way they do this is by keeping three men employed at this work all the time.

THE AMERICAN ROLLER BEARING COMPANY, of Boston, Mass., is manufacturing and placing on the market a new system of roller bearings which, in durability and ease of running, are claimed to far exceed anything yet produced. These bearings are especially adapted for automobiles of all kinds. A few months ago these bearings were tested by the New York Electric Vehicle Transportation Company on several of their vehicles. In one of these tests it is stated that a battery, charged to run a vehicle with ordinary bearings 18 miles, ran 26 miles with the same battery charge when the American roller bearings were placed on the same vehicle. Several of the largest manufacturers of automobiles have adopted the American roller bearings for their vehicles. The Riker Electric Vehicle Company will have an automobile on exhibition at the Paris Exposition fitted with these bearings, and the American Roller Bearing Company will have an extensive exhibit of bearings at the exposition. The company has extensive manufacturing facilities and expects to push the sale of its bearings in both foreign and domestic markets.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, having outgrown its quarters in the Wyatt Building, Washington, recently moved its Washington (D. C.) offices into the Sun Building, No. 1317 F Street, N. W. The present commodious offices were fitted up under the direction of the manager, Mr. Walter H. Whiteside. This company has closed the following government contracts among others within the past 12 months, viz.: A complete power plant, aggregating 2700-hp, for the new dry dock in the Navy Yard at Boston, Mass.; a complete power plant for the Brooklyn Navy Yard, aggregating 2000-hp—this plant will be equipped with polyphase apparatus; a complete lighting plant for the Portsmouth (N. H.) Navy Yard, 400-hp capacity; a complete power plant for the Bureau of Engraving and Printing, Washington, D. C.; a complete plant, including engines and generators, has lately been installed in the State, War and Navy Building; this plant also furnishes power and light to the White House. In the Gun Factory and Cartridge Works, at the Washington (D. C.) Navy Yard, have recently been installed motors aggregating 400-hp. Among the other smaller contracts with the government may be noted the electrical apparatus for the post office, Boston, Mass., and the Smithsonian Institution, Washington, D. C., etc.

ARTISTIC McROY CATALOGUE.—Mr. John T. McRoy, of New York, has just issued a very handsome catalogue of McRoy vitrified clay conduit. It is of the highest artistic order, both as to printing and illustrations, and the text affords extremely interesting reading, the subject being handled in a manner that will hold the close attention of the reader from the front to the back cover. The method of manufacture and the advantages of these conduits are clearly brought out, and in reading the story one gets a very clear idea of what McRoy conduits are, how they are made, how they are laid, and what they are used for. The illustrations, which are very artistic and attractive, are made from actual photographs and beautifully finished. Among the many installations represented are views of those of the Third Avenue and Metropolitan street railways, in New York City; the Brooklyn Edison Company, Pennsylvania Manufacturing, Light, Heat & Power Company, Philadelphia, and many others throughout the country. A list of the largest users of conduits in the United States is given, and this is followed by a set of specifications. The catalogue, which is printed on heavy coated paper, has a handsome buff cover with flaps. On each of the flaps is a heavily embossed representation of a Tanagra terra-cotta figurine. The embossing is well executed, the subject being of a classical nature. It may be mentioned in this connection that there are 15,000,000 feet of McRoy conduit underground.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MARCH 27, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

645,933. TELEPHONE; M. Beck and E. Ferrant, Minneapolis, Minn. App. filed July 18, 1899. Opposite the diaphragm is placed a spiral contact extending from the edge of the diaphragm inward to near its centre, the spiral gradually receding from the diaphragm as it approaches the centre. The movements of the diaphragm cause contact to be made with a greater or lesser number of the convolutions and so correspondingly alter the resistance.

645,943. DYNAMO ELECTRIC MACHINE; G. Daten and A. Hultqvist, Stockholm, Sweden. App. filed Oct. 5, 1899. (See Current News and Notes.)

645,958. TELEPHONE SYSTEM; A. K. Keller, Philadelphia, Pa. App. filed Feb. 6, 1899. The introduction of the operator's plug for the purpose of establishing connections after the operation of the calling signal, is made to restore the drop to such a position that it will respond to the ringing off by the subscriber, while the withdrawal of the plug by the operator for the purpose of disconnecting the subscriber's line after the ringing off again restores the drop to a condition in which it will serve as a calling signal.

645,959. TELEPHONE RECEIVER; A. K. Keller, Philadelphia, Pa. App. filed Feb. 6, 1899. The invention consists of certain devices for mounting and adjusting the magnet in the shell of the receiver.

645,960. TELEPHONE TRANSMITTER; A. K. Keller, New York, N. Y. App. filed Nov. 28, 1899. The transmitter is provided with a rotatable carbon dust holder, having in its interior an eccentric recess whereby the carbon is thoroughly loosened up by the rotation of the holder.

645,978. SECONDARY BATTERY; W. L. Silvey, Dayton, Ohio. App. filed Nov. 20, 1899. (See Current News and Notes.)

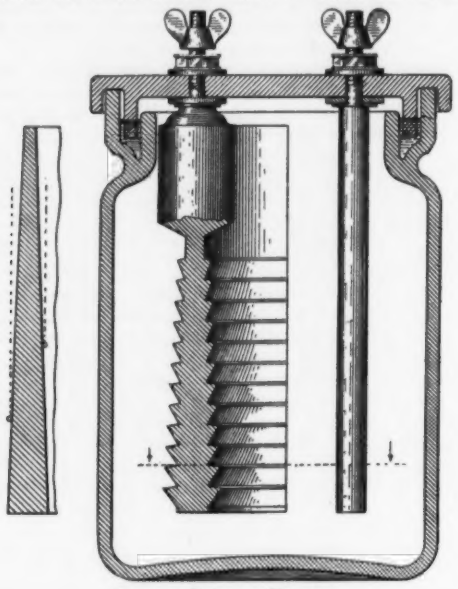
645,984. ELECTRICAL SWITCH; J. C. Tournier, Schenectady, N. Y. App. filed Sept. 25, 1899. One of the contact springs is made of metal differing from that of which the other is made.

645,990. TROLLEY WHEEL; R. S. Windsor, Alexandria, Va. App. filed July 18, 1899. The wheel is provided with projections which extend from opposite sides and from opposite edges of the wheel and which are out of line with each other; they serve to catch the wire as it is leaving the groove in the wheel and return it to position.

645,992. PRIMARY BATTERY; F. B. Badt, Chicago, Ill. App. filed April 4, 1898. The negative electrode is made thicker at the bottom than at the top so as to give it inclined sides from which the hydrogen bubbles will easily separate and rise to the surface of the solution.

646,009. DEVICE FOR ELECTRICAL CONNECTIONS; M. Pfatischer, Philadelphia, Pa. App. filed Nov. 24, 1899. To prevent water which follows the conductors from reaching the contact inside of a lamp receptacle or similar device, the terminals of the conductor are crooked just before they reach the binding screws, inside of the receptacle, so that the water will be shed before it reaches the binding screws.

646,068. ELECTRIC SWITCH; J. L. Creveling, New York, N. Y. App. filed June 10, 1899. This is a centrifugally operated switch interposed between a dynamo and a storage battery, means being provided whereby the speed at which the circuit shall be made or broken can be adjusted.



645,992.—Primary Battery.

646,092. DYNAMO ELECTRIC MACHINE; B. G. Lamme, Pittsburg, Pa. App. filed June 30, 1899. (See Current News and Notes.)

646,100. THERMOSTAT; C. B. Rogers, Stevenson, Md. App. filed Oct. 28, 1899. A thermometer tube is mounted upon a pivot so that it will tilt and close a circuit when the mercury is transferred from one side of the pivot to the other.

646,110. AMMETER; P. H. S. Spies, Yonkers, N. Y. App. filed Aug. 18, 1899. The instrument comprises an iron part inductively influenced by a current-carrying conductor, the iron part consisting of a shell having sloping ends; and a movable iron part embraced by the shell and carrying an index.

646,114. PORTABLE ELECTRIC LAMPS; A. F. Vetter, New York, N. Y. App. filed Oct. 11, 1899. Structural details for applying an electric lamp and battery to an ordinary carriage lamp case.

646,121. DUPLEX MUTIPLE METALLIC TELEPHONE SYSTEM; F. C. Hughes, Detroit, Mich. App. filed Jan. 29, 1898. General improvements throughout the central office apparatus.

646,146. SNAP SWITCH; G. W. Hart, West Hartford, Conn. App. filed June 21, 1899. Details of construction.

646,147. ELECTRIC MOTOR; H. F. Joel, London, England. App. filed Feb. 4, 1899. (See Current News and Notes.)

646,149. METHOD OF PROTECTING ELECTRICAL CONNECTIONS; J. Langton, New York, N. Y. App. filed June 21, 1899. This is a method of protecting electrical connections which are exposed to salts from any source such as from the solution of a battery or electrolytic tank, and consists in immersing the connection in a vessel of water. The water dissolves the salts and holds it in suspension to prevent depositing upon the contact surfaces of the connection.

646,150. ELECTRICAL CONNECTOR; J. Langton, New York, N. Y. App. filed Aug. 1, 1899. This patent is for the construction of the connection utilized in practicing the method described in the preceding patent.

646,155. ELECTRICAL RAILWAY SWITCH; P. E. Perry, Boston, Mass. App. filed Aug. 17, 1899. A plunger is attached to the switch tongue and this is struck by a rod actuated from the core of a solenoid, the solenoid being automatically energized and de-energized by the car co-operating with certain rail sections.

646,169. APPARATUS FOR ELECTRICALLY CONTROLLING ENGINES, MOTORS, OR OTHER MACHINERY; W. H. Harfield, London, England. App. filed Jan. 16, 1899. With this invention the valves of an engine may be controlled from a distance by means of an electric motor, which is itself controlled by a manually operated device.

646,179. ELECTRIC COUPLING; R. D. Ireland, Winthrop, Mass. App. filed Jan. 12, 1897. A peculiar construction of plug and socket fitted with springs for good contact.

646,222. ELECTRIC BELL; F. and H. F. Keil, New York, N. Y. App. filed Sept. 7, 1899. The armature of the bell magnet is attached so that it can be turned away from the poles of the magnet when it is desired to clean or adjust the spring contact.

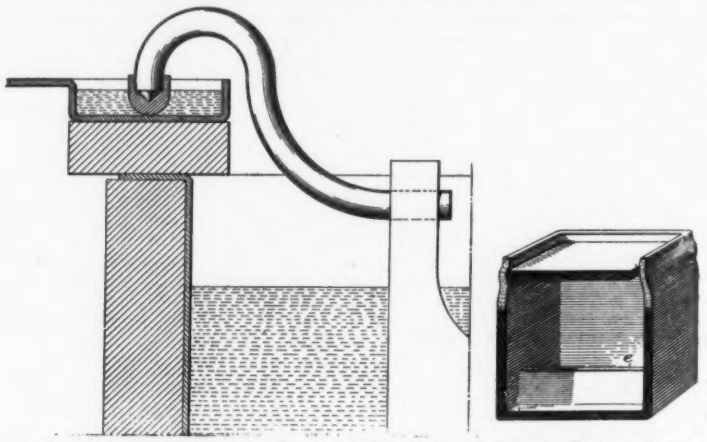
646,229. SURFACE CONTACT SYSTEM OF ELECTRIC RAILWAY; R. Lundell, New York, N. Y. App. filed July 12, 1899. An improvement on the system described in patent No. 625,512, consisting in means for energizing the section ahead of the car before the contact shoe actually reaches it.

646,281. ELECTROLYTIC APPARATUS; L. H. A. B. M. Hazard-Flamand, Boulogne-sur-Seine, France. App. filed Sept. 22, 1898. (See Current News and Notes.)

646,307. VESSEL INDICATOR; A. L. McCormick, Port Huron, Mich. App. filed Feb. 15, 1897. With this device the draft and level of a vessel can be ascertained at any time while loading and unloading. A weight resting on the bottom is attached to a cord extending to the vessel and passing round a drum, a spring tends to rotate the drum in one direction, and the weight in the other. The direction in which the drum turns and its extent gives the required indication.

646,308. AUTOMATIC REGULATOR FOR ALTERNATING DYNAMOS; G. S. Neeley, Pacific, Mo. App. filed June 7, 1898. Improvements in the details of construction of a machine described in another application for patent.

646,309. INDUCTION MOTOR; G. S. Neeley, Pacific, Mo. App. filed June 7, 1898. The object of this invention is to make an induction motor whose field can be adjusted to various positions with relation to the armature for regulating the speed and torque of the motor without disturbing other elements of a system in which the motor may be employed.



646,149.—Method of Protecting Electrical Connections. 646,325.—Battery Jar or Receptacle.

646,325. BATTERY JAR OR RECEPTACLE; E. A. Sperry, Cleveland, Ohio. App. filed April 22, 1899. The jar is made of rubber, the lower portion being hard rubber and the upper portion or edges being soft rubber, so that a cover larger than the mouth of the jar can be inserted therein and gripped to make a tight joint.

646,348. SECONDARY BATTERY; H. Blumenberg, Jr., and F. C. Overbury. New York, N. Y. App. filed Dec. 1, 1898. (See Current News and Notes.)

646,362. ROENTGEN RAY APPARATUS; J. M. Davidson, London, England. App. filed Sept. 22, 1899. This invention has for its object to provide means that will produce stereoscopic images on a fluorescent screen, and for this purpose the framework is provided with two sight poles through which intermittent and rapidly alternating shadows are projected, the holes being opened and closed alternately.

GERMAN PATENTS, ISSUED MARCH 7, 1900.

[In Charge of Dr. Ralph Julian Sachers, 120 Liberty Street, New York.]

107,434. VACUUM LIGHT; Philip L. Volk and Wilhelm Josef Vesely, Prag. App. filed Aug. 25, 1898. An exhausted receiver of annular cross section surrounds an induction coil having a self-interrupter. This self-interrupter, which is enclosed within a small exhausted receptacle, consists of two paramagnetic bodies which repel each other, and is located within the iron core of the primary and in circuit with the primary.

107,513. STORAGE BATTERY; Wilhelmine Graeber, Basel. App. filed Dec 6, 1898. A metal frame is placed around a lead plate, by which the active material is supported. A movable bar is pressed against the active material by means of a pair of spiral springs located in a casing filled with grease.

107,680. MICROPHONE; Société Industrielle des Téléphones, Paris. App. filed Jan. 14, 1899. A casing is closed on one side by a conducting plate and on the other by a diaphragm. The space between is filled with granulated carbon. Two annular rings separate the plate from the diaphragm. An insulating ring is placed between the two rings. One pole of the battery connects with the metal plate and one of the rings, and the other pole with the diaphragm and the second ring. The current passes through the granulated carbon and its path through a relatively large bulk of carbon, is very short, the annoying, crackling noise being thereby avoided.

107,726. ACTIVE MATERIAL FOR STORAGE BATTERIES; Arthur Heinemann, Berlin. App. filed June 12, 1898. Oxides of lead are mixed with ethereal oils from the Cupressineae, Cupuliferae and Abieteneae (cypress, fir, etc.) family.

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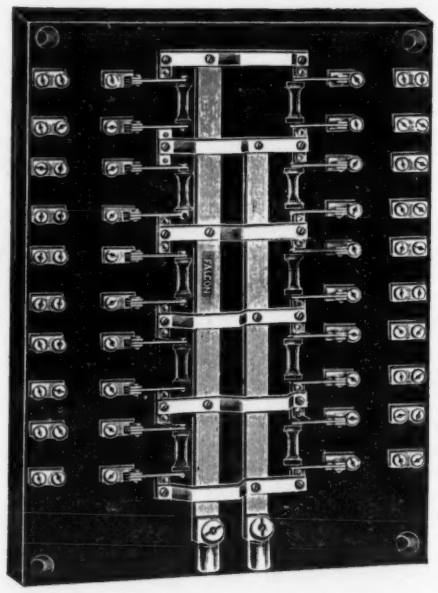

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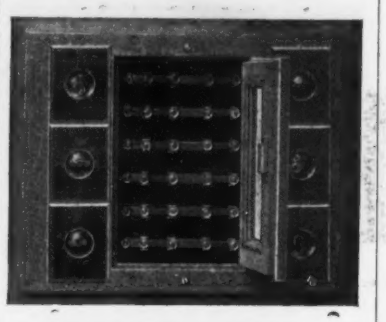

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Union Boiler Tube Cleaner Co.

TWIST DRILL GRINDERS.
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VULCANIZED FIBRE.
Vulcanized Fibre Co.

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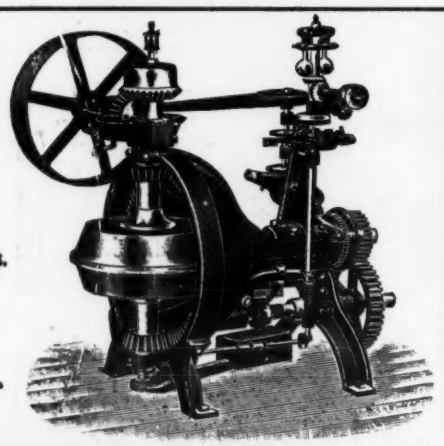

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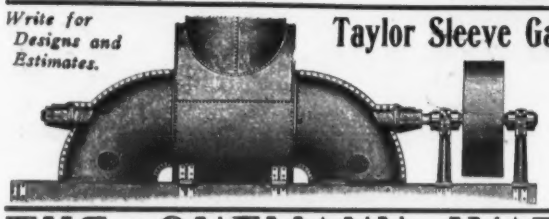

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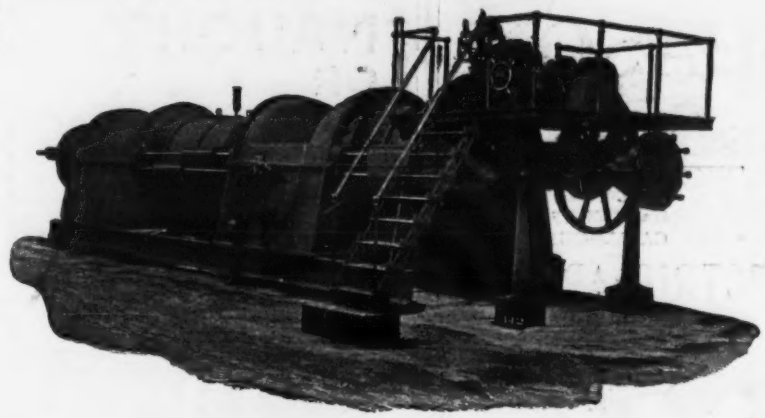

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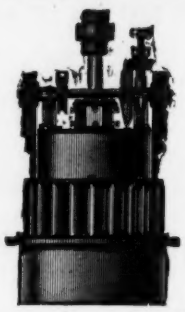

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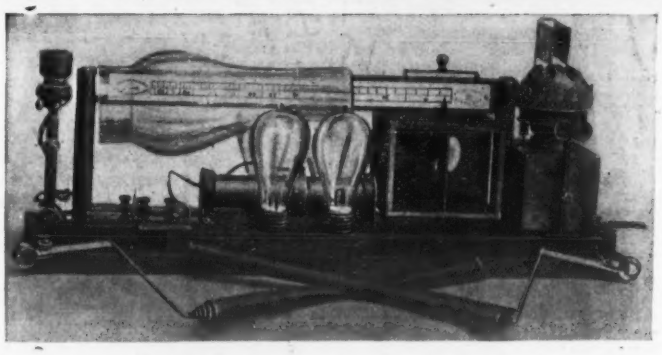

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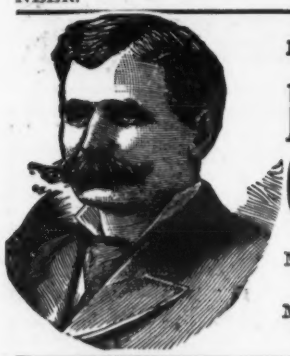

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